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A Novel Method of Testing Cast Iron for Hardness.

Who knows of an entirely satisfactory test for the degree of hardness of iron? There is a very scientific test in which a standard weight falls from a standard hight and with a standard punch makes an indentation, the depth of which, when carefully determined by a delicate and refined measuring instrument, is taken to indicate the relative degree of hardness.

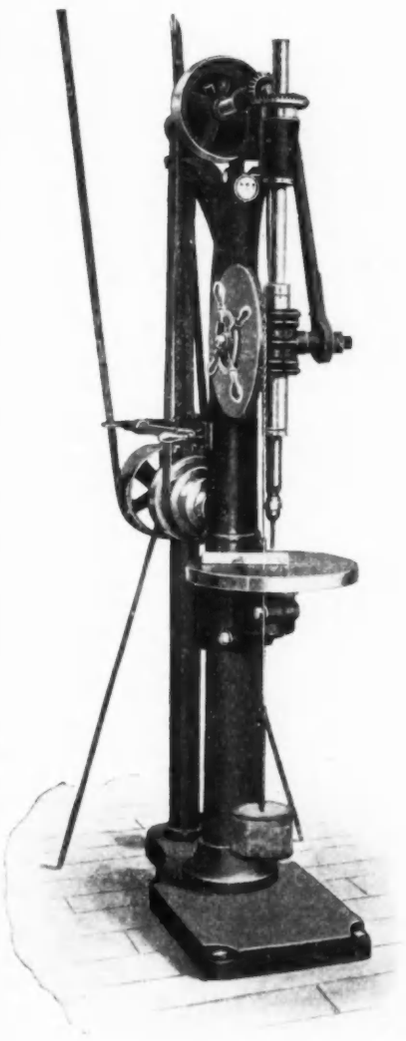
Chas. A. Bauer, general manager of the Warder, Bushnell & Glessner Company, at Springfield, O., does it in a much simpler manner by a plan which can be folloyed by anyone, involves almost no special appliances and, we have reason to believe, gives accurate knowledge.

From every heat poured in the foundry three test bars are cast. These bars are 12 inches long and .8 inch square section. They are submitted to transverse tests to determine their strength and one or more of the pieces are then taken to the machine for testing hardness, an engraving of which is given herewith. It is nothing more than a Pratt & Whitney No. 1 manufacturers' drill with a few additions.

On the pinion shaft which works the feed is a disk of wood about 12 inches diameter, and passing partly around its circumference is a piece of plumbers' chain, to the free end of which is attached a wire which passes down through a clearance hole drilled in the table; below which it carries a number of weights like those used on weighing scales.

At the left of the upper spindle box is attached a cyclometer, such as are used on bicycles, and in a collar on the spindle just below this box there are some small pins which, as the spindle revolves, turn the star-wheel of the cyclometer and thus make it indicate the number of revolutions of the spindle. It does not indicate them directly, however, because to do this was found to agitate the star-wheel too violently. And some pins were removed so that the ratio of speed of cyclometer to spindle is now such that the reading is multiplied by the constant 1.44 to give the drill revolutions.

In the chuck is a flat drill 3/8-inch diameter, and this drill is carefully ground in the tool room by aid of a fixture to a known thickness, angle of lip, etc.; though this uniformity of grinding is not depended upon solely for the accuracy of the results.



DRILL PRESS FIXED FOR TESTING HARDNESS.

When a test is to be made the test-bar is placed on the table and the drill, not yet rotating, is brought down upon its surface, the feed lever is unlatched and everything is as shown; the cyclometer being set at zero. The drill is then started and the descending weights provide the sole power for the feed. When the drill breaks through and the weights fall upon the base-plate below, the cyclometer reading is noted, and thus the number of revolutions of the drill required to drill through the bar is known.

Previously the number of revolutions required for drilling through a bar of standard hardness has been determined, and by "standard hardness" is meant an iron which is not so hard but that it can be worked readily and which experience has shown to be generally satisfactory, both from a foundry and from a machine shop point of view.

The number of revolutions required to drill through such a bar, with this standard drill and under the given conditions, is known, or can at any time be demonstrated by trial, and the principle of the test is based upon the fact that a harder or a softer bar will require a correspondingly greater or a less number of drill revolutions to go through it.

Experience has proven that very accurate results are secured in this way, and the uniformity in the reading of the cyclometer when drilling different holes through the same bar is one of the most remarkable things about it; this, of course, showing that all other conditions remain practically constant, and that it is therefore a justifiable conclusion that, when one bar requires materially more revolutions than another, it is for no other reason than because it is materially harder.

The writer saw two holes drilled through the same bar; one of them required 327 revolutions, the other 323; a difference of only 1.2 per cent. All conditions were the same for these two holes, but afterwards the speed of the drill was materially reduced and 356 revolutions (an increase of 10.2 per cent.) were required for a third hole through the same bar. This and numerous other tests as well, have demonstrated the curious and wholly unexpected fact that, when a drill is run below its normal or proper speed, it not merely requires more time to drill the hole (which is what we expect), but that in the absence of a positive power feed, it actually requires the drill to make more

revolutions in getting through, which is what we do not expect.

Mr. Bauer's formula for speed of drills is $\frac{140}{d}$ revolutions per minute. This would give 373 revolutions for a ⅜-inch drill, and in testing this speed is approximated as closely as may be. The effect of changing the speed of rotation seemed so curious that we asked Mr. Bauer for some further information regarding it, and he sends us the accompanying table:

Three-eighth-inch Holes Drilled through Cast Iron .8 Inch Thick—Different Revolutions per Minute.

Time in Seconds.	Revolutions per Minute.	Revolutions to Drill through ⅜-Inch.
261	79	345
139	142	332
75	238	298
47	357	280
39	434	282

Respecting this table, Mr. Bauer writes:

"The drilling in this case was done with a ⅜ drill through the same piece, which was practically .8 of an inch thick, and the variation of time required was from 39 to 261 seconds, with a variation of revolutions per minute of from 434 to 79. The formula which I adopted many years ago for revolutions of drills, which no doubt you will remember, is 140 revolutions for an inch drill, and inversely as the diameter of the drill for other sizes. This would make the most economical speed for a ⅜ drill about 373 revolutions per minute, but as we could not run the drill just that speed, we had to change from 357 to 434, which was too fast for economical work. You will notice that the slower the speed of the drill the more revolutions it required to drill through the same thickness of metal, and as the speed increased, it required less revolutions until we reached the economical speed. This is another proof of the correctness of my formula for speeds for economical work.

"After these tests were made, we repeated one of the first tests with a slow speed, and got practically the same results as in the first drilling. This was done to prove that the condition of the drill had not materially changed during the test.

"The constant pressure on the drill while drilling was 160 pounds, which pressure was taken by actual weights, as we did some work under these conditions when the work was on a small platform scale, in order to show that the pressure was constant while the drill was in motion.

"This arrangement for testing the hardness of iron has been proven to be very reliable, as we can repeat the tests with practically the same results, and a slight variation in the hardness of iron is at once detected."

The drill-press shown stands in Mr. Bauer's testing laboratory and is driven by an electric motor. He apologized for what he called the crudeness of the appliances, and said he would rather wait until he had carried out his intention of rigging up the drill permanently, and in better form, before having anything published about it, but kindly yielded to persuasion on the point.

A belt will do for driving, if no motor is at hand, and this method of testing, intelligently used, ought to enable any shop proprietor or foundryman to know just how his castings are, with respect to hardness, before the machinists find out, which is a great advantage very often.

▲ ▲ ▲

The Construction of the Hindley Worm—II.

The first unexpected peculiarity manifests itself in cutting the wheel, and can be best explained by the sketch Fig. 6, which, however, represents the hobbing of a common worm exaggerated in some particulars. The hob and wheel blank are so geared together that the pitch line of the wheel shall travel at the same lineal speed as that due to the pitch of the hob. This means that, in consequence of its increased radius, the speed of the outer circumference of the wheel blank

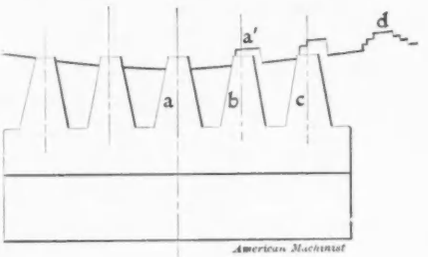


Fig. 6

CAUSE OF STEPS.

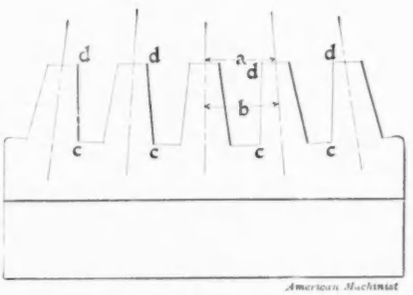


Fig. 7

HINDLEY FORM OF TEETH.

will be greater than is due to the hob pitch. If we imagine for a moment the cutting to begin with tooth *a* of the hob, it will take a bite as shown, but when the wheel blank has traveled to a point where tooth *b* acts, the blank will have traveled *too far*. The cut taken by *a* will occupy the position *a'*, the cut taken by *b* will not be central with *a'*, but offset as shown. The same action will be repeated by tooth *c*. Meanwhile a similar action in reverse order has been going on to the left of tooth *a*, and when this cut finally leaves the hob it will be of the form shown at *d*—which is no more like the shape of the hob teeth than if they had never been together. Although this action takes place at the commencement of cutting a common worm, mechanics with whom we have discussed the matter declare they never noticed it. With the common worm, however, the action described is soon obliterated as the cut proceeds, because

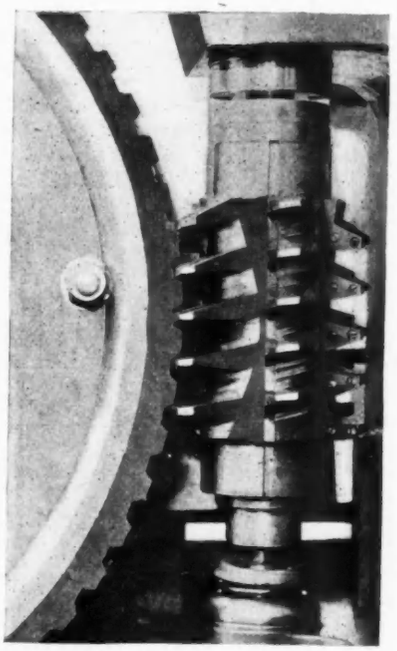


Fig. 8. BEGINNING OF CUT.

the inclined sides of the outer teeth of the hob pare down the stepped surface as the hob sinks into the blank. With the Hindley construction, however, the hob teeth radiate in section from the worm wheel center, as shown in Fig. 7. The sides of the hob teeth facing the center of the hob's length get straighter and straighter as they leave that center, the last one being radial to the worm, as shown. So far as the insides of the Hindley hob teeth are concerned, then, there is not sufficient paring action to remove the steps. The outer sides do part of the paring, but still not enough to remove the steps, and the Hindley hob has to be so modified as to bring the steps cut down to a point where the outsides of the teeth will remove them. This modification has been made in the hobs shown. Were the hob made according to the usual conception, the steps would be even more pronounced than they are shown, but made as it is, the hob removes the steps before the wheel is finished.

But for this modification of the Hindley hob, the initial action would be more pronounced with the Hindley than with the common worm. First because the teeth are in practice made deeper, giving a greater difference in speed between the pitch line and the outer circum-

ference, thus making wider steps, and secondly because of the teeth of the Hindley radiating from the center of the wheel. It is obvious on inspecting Fig. 7 that the pitch at *a* is less than at *b*, whereas in the common worm these pitches are equal. In other words, the increased travel of the outer circumference of the wheel finds in the common hob, at the begining of the cut, a pitch line pitch, while in the Hindley it finds a reduced pitch. The excess of travel of the wheel over the pitch of the hob teeth, where the cutting is being begun is therefore greater with the Hindley form, and the steps would be more pronounced but for the changes in the hob to be described.

As we believe this action to be new to many, and as perhaps some may even doubt its occurrence, we present Figs. 8 and 9 which are from the wheel already shown in the general view of the machine, Fig. 5. Fig. 8 is a square, front, close view of the wheel in the early stages of the cutting, and plainly shows the steps, as well as the action of the successive teeth of the hob. The cutting teeth of the hob move from the observer, and it will be seen how the first (lower) tooth cuts out one side of the space in the wheel, while the second tooth has its point of action nearer the center of the space, and the middle tooth is truly central with the space. Beyond this the teeth act farther and farther away from the center, the last one acting at the opposite side from the first one. This action with the machine in motion is extremely interesting, and this cut fairly represents it. Fig. 9 is another view of the same wheel from a different point of view, and shows the actual form of the steps still more clearly. Fig. 10 shows the action of the hob when the wheel is nearly finished, the the steps having been removed as will be seen. How this has been accomplished will be seen later.

There is another and still more peculiar development, requiring a change in the worm similar to that required in the hob to get rid of these steps; consequently this change in the hob will not be described until the second development has been explained.

The fundamental idea of the Hindley gear is that the wheel is cut by a hob which is a true representative of the worm, and the worm is cut by a cutter head which is a true representative of the wheel. Nevertheless it is found that *a wheel and a worm so cut will not go together and cannot be made to go together.* This is a point which is not readily understood from the gears themselves, which do not disclose the hidden geometry of their forms but the reason will be plain from Fig. 11, which is a section of the worm with a tool of the cutter head in place, and with the wheel shown in dotted outline. The difficulty grows out of the fact that the cutter head is not,

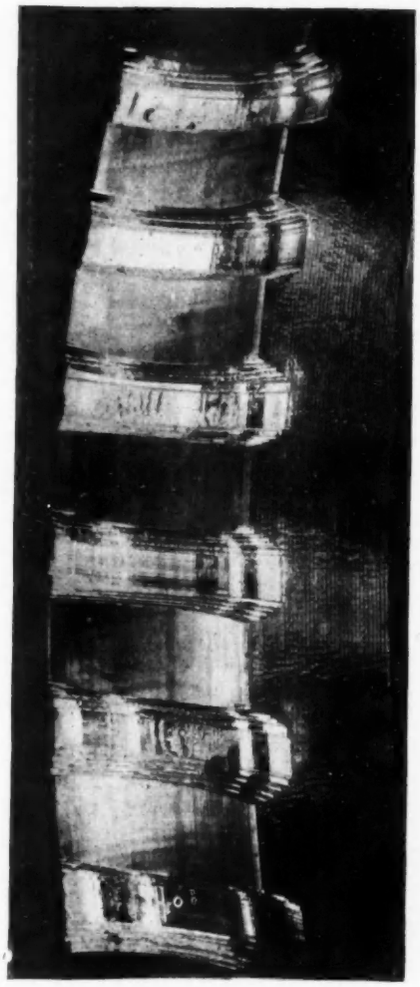


Fig 9. STEPPED SIDES OF TEETH AT BEGINNING OF CUT.

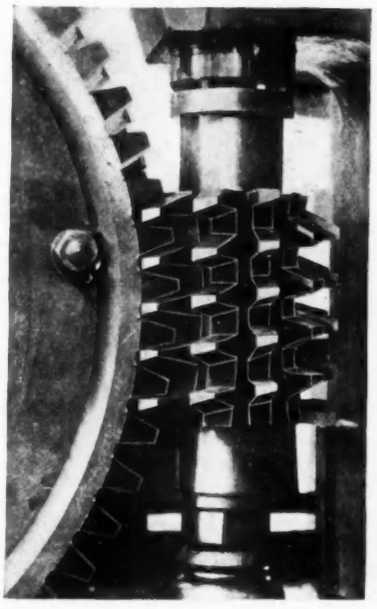


Fig. 10. COMPLETION OF CUT.

as presumed, a true representative of the wheel, but of *its median section only.* Were the wheel a mere template of thin sheet metal, it would go in where the cutter head came out, but the actual wheel has substantial thickness and embraces an arc of the worm, and it is at the outer ends of the wheel teeth at *f* that interference occurs.

Going back to Fig. 7, it will be recalled that the pitch of the worm teeth at *b* is greater than at *a*, and again at the bottom of the teeth the pitch is still greater, and it is from this in combination with the thickness of the wheel that the difficulty arises. In Fig. 11 the extreme point *a* of the tool is at a radius *r* from the cutter head center, and cuts a corresponding pitch at the root of the worm thread. Drawing the perpendicular *a b* we find point *c* of the wheel tooth, which is at the same radial distance *r* from the

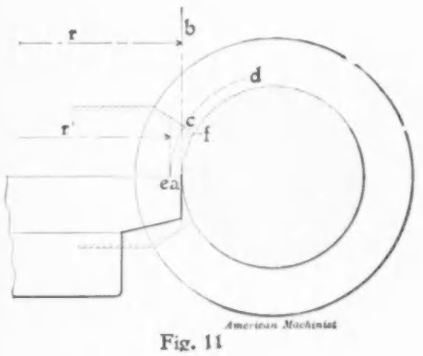


Fig. 11

CAUSE OF INTERFERENCE.

cutter head center as *a*, travels at the same speed and requires the same pitch in the worm as that cut by *a*. Point *c*, however, meshes with the worm on the circle *c d*, which was not cut by point *a* but by *e*, which is at a radial distance *r'* from the center of the cutter head. Point *c* of the wheel requires a pitch in the worm as cut by *a*, but finds one as cut by *e*, which latter is not large enough to accommodate the wheel. At point *f* the interference is of course still worse, but the explanation is clearest with reference to point *c*.

It will thus be seen that a worm and wheel cut as the Hindley gear is supposed to be cut, is a mechanical impossibility, and the question is, what modifications can be made which will make it practicable? It will be seen that point *c* of the wheel, Fig. 11, is spread too far to enter the worm threads, and the first suggestion would be to re-hob the wheel with a hob which should cut down the thickness of the teeth at *c*, but to do this would be equivalent to cutting away the tooth at *c* entirely and so destroy its usefulness in providing wearing surface. The only other alternative is to cut away the sides of the worm on the inner sides of the threads at *c d*, Fig. 7, as it is these sides which interfere. Their use-

fulness as wearing surface is, of course, at an end, but the opposite sides of the worm teeth are unimpaired, and while the remaining surface is not so large as the Hindley construction is supposed to provide, it is still far in excess of what can be obtained with a common worm.

Reference to Fig. 6 will show that it is shown in the engraving. No change is made in the gearing which connects the cutter head and hob blank, and the new head is adjusted so that it shall pass the central space on the hob without in any way altering that space, but the increased speed of the teeth, due to their greater radius, causes them to cut out the sides

The worm is cut in precisely the same way as shown in Fig. 12, a cut being first made with a cutter head of the same diameter as the worm wheel, and a second cut following the first with a head of increased radius, the increase being shown by the distance *x*.

A large amount of time has been de-

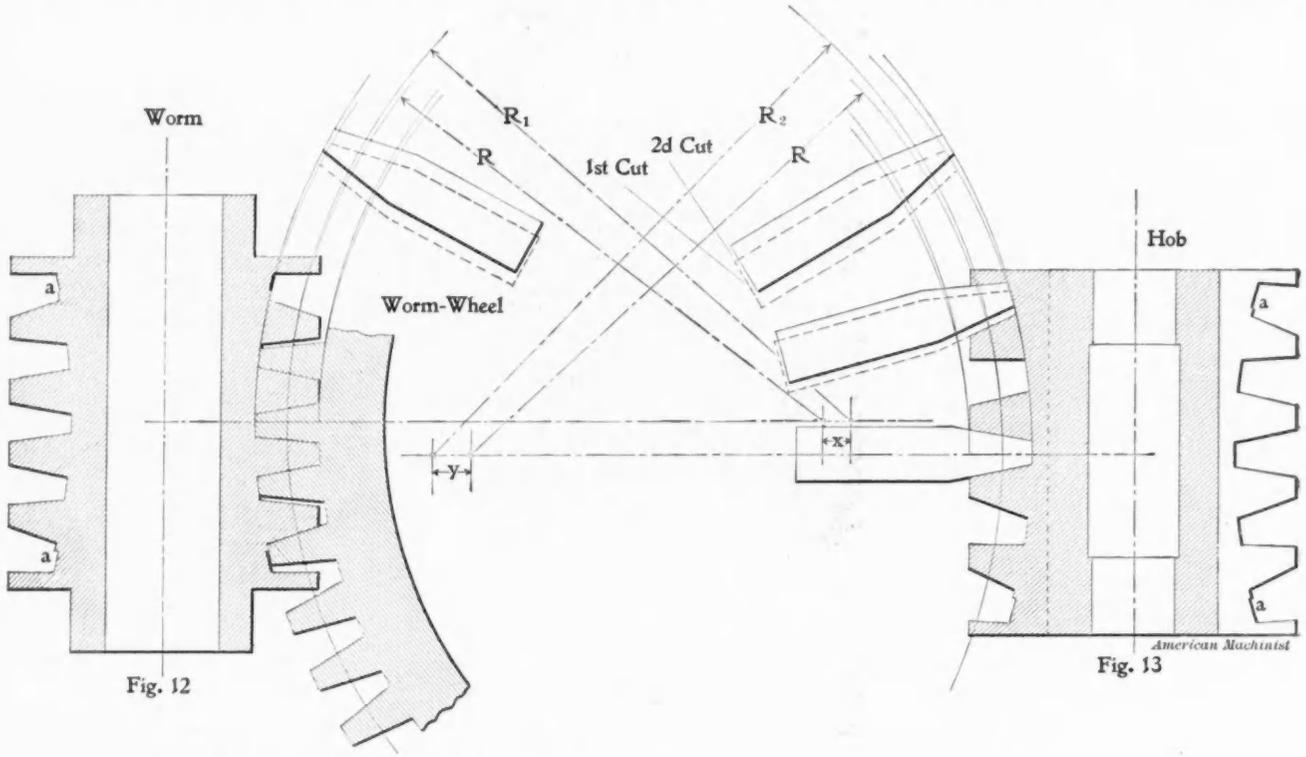


Fig. 12 Fig. 13

R = Regular Pitch-Radius (For 1st Cut)
R_1 = Increased " " Worm (" 2d ")
R_2 = " " " Hob (" 2d ")

MODIFICATION OF WORM AND HOB, AND CONTACT BETWEEN TEETH.

the inner corners of the hob teeth that cut the curious stepped surface, and the cutting away of the inner sides of the worm teeth suggest the same line of action with the hob teeth. This is, in fact, done, the hob being altered in the same manner as the worm. The hob teeth are not cut away sufficiently to entirely do away with the initial steps, but only so much as shall reduce those steps to a point where they will be pared away when the hob sinks into the wheel blank. The wheels shown in the accompanying illustrations were cut by the altered hobs, which, as will be seen by Fig. 10, removed the steps before the cutting was finished.

It remains to show how the change in the form of the worm and hob teeth is made, and for this we refer to Figs. 12 and 13, of which the former shows the worm and the latter the hob. The hob is first cut with a cutter head as described, having a diameter equal to that of the worm wheel. The full line tooth on the center line, and the dotted line teeth above, show the positions and cuts made. Now when this cut is completed, a second cutter head is placed in the machine, having a greater radius than the first one by the distance *y* of the remaining hob spaces farthest from the center lines, that is, the lower sides of the lower half of the hob teeth, and the

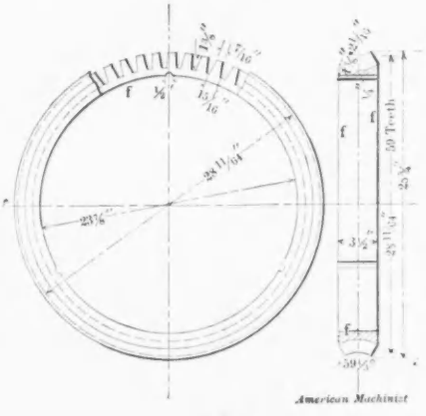


Fig. 14

THE WHEEL.

upper sides of the upper half, the position of the teeth in the second cutter head and the cuts taken by them being shown by the dotted outlines. Incidental to this cut is a slight jog at the bottom of the space shown at *a a*.

voted to the endeavor to determine the values of *x* and *y* mathematically, and so deduce a formula which should be a guide for worm gearing of any size. So far, however, this has not been successful. The problem is quite complicated. No less than five factors enter into it, namely, the circular pitch, the number of teeth, the depth of tooth, the angle of tooth and the face angle by which the wheel embraces the worm. For the present case, the problem has been worked out at the machinist's court of last resort—cut and try. It should be said, however, that the distance *y* for the hob is greater than *x* for the worm.

These Figs. 12 and 13 have been made by Mr. C. C. Stutz, mechanical expert of the Sprague Co., with great care. In addition to the points already noted, Fig. 12 shows the character and extent of the contact between the teeth. It will be noted that there is no clearance at the roots of the teeth, and that the character of the contact is very peculiar. While the middle tooth engages on both sides, the others engage on one side only—the lower side for the upper half of the worm, and the upper side for the lower half. This

means that if the worm drives the wheel downward, the lower teeth alone act, while if it drives it upward the upper ones act. In other words, the arc of action is confined to the arc of recess. If the worm were to drive the wheel in one direction only, that side of the worm occupying the arc of approach might be omitted. The drawing shows how superior is the contact over that secured by the common worm, which latter is that due to a spur gear and rack only, that is, in section, at a point only for each tooth. It is proper to add that the contact shown in the drawing has been verified by cutting a wheel in halves and applying it to its worm.

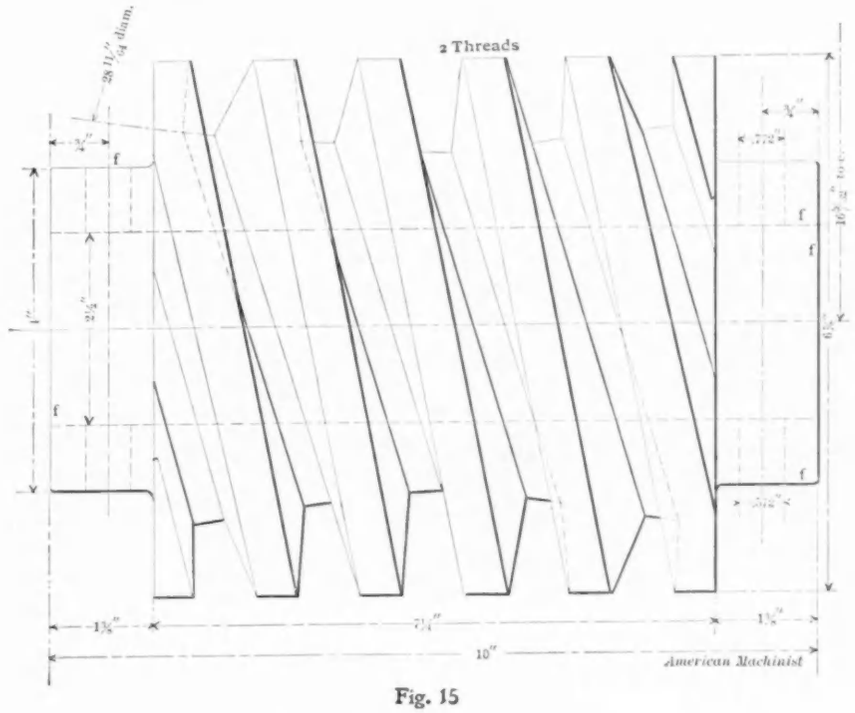
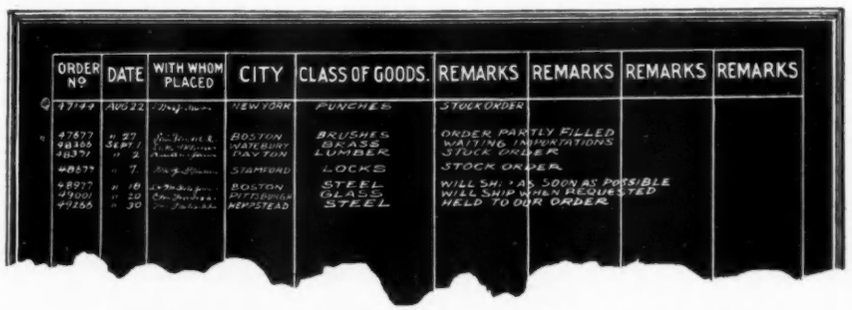


Fig. 15

THE WORM.



PURCHASING AGENT'S "ORDERS OVER TWO MONTHS OLD BOARD."

An Unique Manufacturing Establishment—II.

In our issue of last week we gave a general account of the plan of administration and some of the special features of the establishment of the National Cash Register Company, of Dayton, O. Limitations of space prevent full illustration and explanation of all the noteworthy details to be found there, and that are freely

Fig. 1. SAMPLE BOARDS OF ARTICLES PURCHASED.

shown to whoever may be interested in them. We can select only a few typical features, which will perhaps serve in some degree to show the originality of the establishment and some of the results of the encouragement to original thinking on the part of all connected with it, mentioned in the first article above referred to.

A prominent feature of the place is its monitor boards and devices of similar nature designed to show at a glance the actual condition of any department of the factory or of the work. In the article above referred to we gave an example of these.

SAMPLE BOARDS.

At Fig. 1 is shown something of the arrangement of the sample boards which

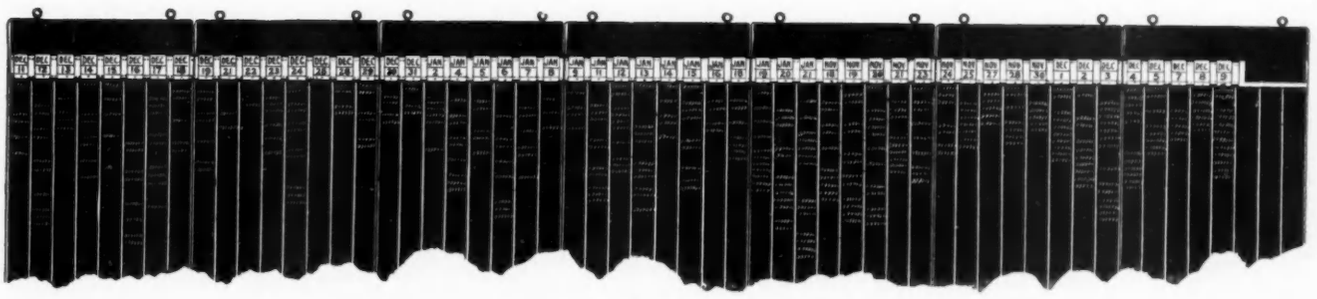


Fig. 2. PURCHASING AGENT'S "ORDERS OVER TWO MONTHS OLD BOARD."

Figs. 14 and 15 are from working drawings of worm and wheel shown in process of being cut in preceding illustrations.

are used in ordering stock. These are in the form of shelves fitted to slide into cupboards. What constitutes the outer edge of this shelf, or the lower edge of the sample board when it is pulled out,

is labeled to indicate the character of the samples upon it. One of the boards has been drawn out and placed in position for photographing. It is devoted to locks, of which a great many are pur-

Fig. 3. PURCHASING AGENT'S REGISTER SHOWING HOW MUCH BILLS ARE AVERAGING.

chased. Below each sample is a card giving full particulars—shop symbol of the piece, date of its adoption, number used on a machine, by whom it is manufactured, etc. Everything purchased is represented on these sample boards, and by the system of classification used can be very quickly found when wanted.

DELAYED ORDER MONITOR BOARDS.

All orders that are for any reason over two months old are posted upon a blackboard, shown in Fig. 2, which is fixed to the wall in the room of the purchasing agent, Mr. Harvey Conover. Below the board are a number of smaller portable ones, hung by screw-eyes and adapted to hold at the top cards bearing the dates as shown. When any order for stock is made out, its serial number is written in the column under the date of the order. When an order has been filled, this number is simply erased; but those numbers which at the end of two months' time are not thus erased are transferred to the large board above, and in the same horizontal line are written the date of the order, name and address of the firm with whom it was placed, what the order was for and the reason why it remains unfilled, if there is any reason. An inspection of the board as it appears in Fig. 2 shows that there are good reasons for delay in some cases. "Stock order" means an order for stock to be shipped as needed.

Representatives of specially delinquent concerns have been strongly impressed by an inspection of this board, and by the fact that the names of their concerns were repeated frequently upon it without good excuse, and have in some cases mended their ways. Aside from this, it shows at a glance what often requires, in other establishments, considerable time to find out.

PURCHASING AGENT'S MONITOR.

Near the board is a device which may be called the purchasing agent's monitor. It is shown in Fig. 3, and it tells at a glance how much per day bills are averaging for the month to date. A limit is set, beyond which it is not desired to go, and this monitor always indicates just how close to the limit purchases are running. In a subdivision of the purchasing agent's department, cash is paid out for supplies furnished by local dealers, or for whatever may be purchased or paid for in currency. For every such payment a receipt is taken, and the date and amount of payment are printed upon this blank receipt by a "National Cash Register," which also at the same time prints date and amount upon a continuous strip of paper wound up within the machine, and adds up the amounts upon a mechanical "totaling" device.

"PREPARE TO MAKE" REGISTER.

Fig. 4 shows to purchasing agent, foremen, or whoever may be interested, just

Fig. 4. "PREPARE TO MAKE DAILY" REGISTER, PLACED AT MAIN ENTRANCE TO ADMINISTRATION BUILDING.

what the factory is expected to do—or, rather, the rate of production desired at the time—and in places within the factory these figures are prominently displayed, so that he who runs may read, and every employé who is in any way concerned thus knows what is expected from him.

MONITOR BOARDS MADE UP OF RECORD CARDS.

Another form of monitor board extensively used here, and which is found to save a great deal of time, avoid delays in ordering stock, and greatly facilitate the orderly movement of affairs, is made up of cards similar to that shown in Fig. 5. This is a card used in the Raw Stock Department. In life it is 3½ inches wide, 9 inches high. At the upper right-hand corner is an eyelet by which is fastened to the back of the card a disk of cardboard having upon it sectors in five different colors, as shown in Fig. 6. These cards, when in use, are dropped into slits formed in a suitable rack fastened to the wall of the stock-keeper's office. When in place, only the upper portion of the card is visible. As changes take place in the condition of the stock to which any particular card relates, the proper entry is made on the card, and the polychromatic disk is turned to correspond. If the disk shows white, the stock is all right, and no one need pay any particular attention to it; if yellow, there is less than a month's supply of that stock; if red, the stock is exhausted. We do not remember what black indicates—possibly that sentence of death has been or will be pronounced upon some delinquent, through whose fault the stock has become exhausted; but however that may be, a glance at the monitor board made up of these cards reveals just what particular stocks need attention, and by removing and inspecting any card, full particulars are obtained.

Similar cards are used in other departments. Mr. Hyde, who edits all the company's publications, and has charge of advertising and art matters, uses similar cards for keeping track of advertisements

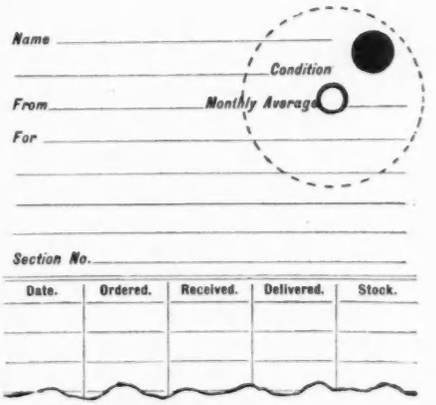


Fig. 5. REDUCED CARD USED IN KEEPING ACCOUNT OF STOCK.

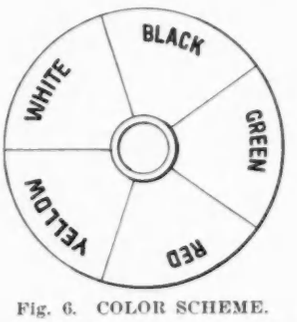


Fig. 6. COLOR SCHEME.

in trade papers, and has an efficient system of keeping account of such advertisements, and for ascertaining whether any given advertisement pays or not.

CATALOG LIBRARY.

The treatment of catalogs is a feature of the Purchasing Department, and there is in course of formation a library, which will be composed of trade catalogs. Its present capacity is 10,000 volumes, with room for growth.

Owing to the great variety of material

purchased, some systematic handling of catalogs and price lists became necessary, and they are now indexed according to the firm names, and also according to the material found in the catalog. The arrangements for quick reference seem to leave nothing to be desired. In this library system are to be found a great many novel and original methods of keeping the books in place; obtaining receipts for loaned catalogs; the arrangement of compartments; self-conforming divisions, and cross and direct indexing. Every piece of material in every catalog is given a separate and distinct number, and when one realizes that some of the catalogs so indexed contain 5,000 subjects, he can appreciate the thoroughness and the great care that is taken in arranging indexes.

USE OF DESIGNATING COLORS.

Colors are also made use of in connection with the various machines made in the factory. For instance, the inspectors' benches are divided into sections, each section devoted to the inspection of parts for a certain machine. The number or title of this machine is displayed above its section of the inspector's bench on a transparent glass sign the color of which sign is the same as that assigned to the particular machine. All parts for this machine are kept in boxes colored to correspond and no stock mover ever takes stock in a red box to a section of the inspector's bench whose sign is other than red, or pays any attention to red boxes in "Clearance House" or factory when after parts belonging to a machine whose designating color is blue or yellow.

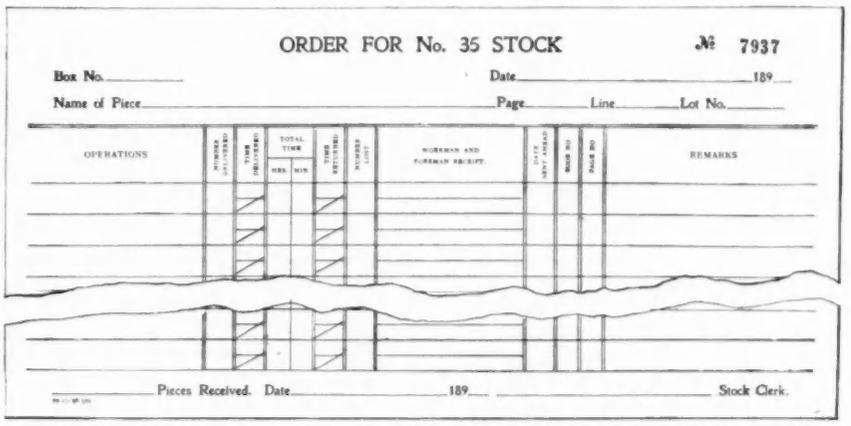
THE CLEARANCE HOUSE.

The inspectors' benches extend around the "Clearance House" which is a room at the end of one of the floors of "Machinery Hall," in which all stock of parts in process of manufacture but not at the time being worked upon are kept, in the colored boxes previously referred to, or otherwise. The color of a box whether it is here or in the factory tells at a glance what machine the parts contained therein are for, while in a metal pocket fastened to the side of each box are placed blank cards which give all particulars regarding the stock, such as, time it should be finished, operations already performed upon it, record of inspection, etc. This plan not only keeps the shop floors clear and clean but it also enables any particular lot of parts to be readily located—it can be in only two places—in the "Clearance House," or in the department of the works in which it is receiving or is to receive the next operation; and this operation and location are indicated by records kept in a small office adjacent to the "Clearance House," past the door of which all stock of parts must pass in going in or out of the "Clearance House."

At Fig. 7 is shown a portion of a blank used in this office for stock parts of the "No. 35" cash register. These blanks are numbered serially as shown at the upper right hand corner. One of them is filled out for each lot of parts ordered for this machine. These are filed and reference to them shows just where the stock is, what operations have been performed upon it, and, in connection with a corresponding record kept in books, whatever else anyone may require to know about the stock.

The men in this department can tell you more about the stock parts that any given foreman may have in his department than the foreman himself can usually tell and anyone who may need to know where any lot of stock is, or what its stage of advancement toward completion may be, can inquire by telephone and in a few minutes the required information in his possession.

Mr. Chas. Griffith, who has charge of the milling machine department, and also looks after the forwarding of work through the factory, and designates when necessary the particular lot or lots of stock that must take precedence, depends much upon the records kept here, and does not have to ask a foreman if he has certain stock or what he has done with it. The record shows all this quickly and infallibly.


ORDER FOR No. 35 STOCK № 7937

Box No. _____ Date _____ 189__

Name of Piece _____ Page _____ Line _____ Lot No. _____

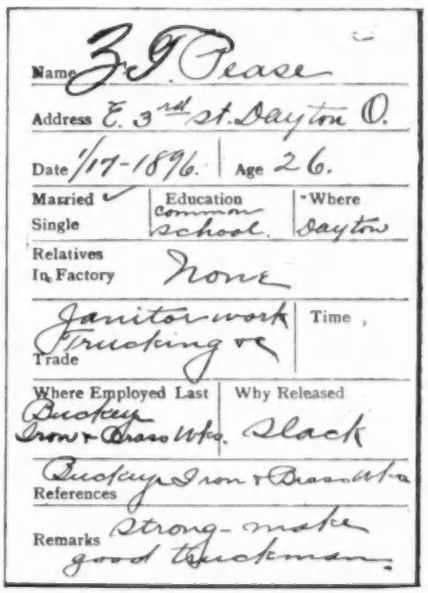
OPERATIONS | TOTAL TIME HRS. MIN. | REMARKS

_____ Pieces Received. Date _____ 189__ _____ Stock Clerk.

Fig. 7. CLEARANCE-HOUSE CARD-SHEET FOR KEEPING RECORD OF STOCK AFTER IT IS STARTED.

BUREAU OF EMPLOYMENT.

Much attention is given here to securing a desirable class of employés and the "Employment Department," which is in charge of R. T. More, is very highly developed and systematized. We all know the usual method of taking on new men in large establishments located in large cities. Every morning a lot of men gather about the door inquiring for work. They are treated with scant courtesy (if any whatever) and if no men are wanted on that particular day they see no one connected with the factory and are turned away. There may be in this crowd of men one or more real jewels—men who perhaps the next day or in a few days may be needed, but instead of being able to hire them, inferior men are taken on from the crowd applying on the day when men are wanted. This, it is almost needless to say, is very unscientific. Its most prominent result is that only by the merest chance are the best men who offer their services employed.


Name E. J. Pease

Address E. 3rd st. Dayton O.

Date 1/17-1896. | Age 26.

Married / Single | Education common school. | Where Dayton

Relatives In Factory None

Trade Janitor work Firemaking &c | Time ,

Where Employed Last Buckeye Iron & Brass Wks. | Why Released Slack

References Buckeye Iron & Brass Co.

Remarks Strong-make good workman.

Fig. 8. APPLICANT'S CARD.

Here every applicant—at least all who may be considered at all likely to be available in case of a vacancy—is asked the questions necessary to enable a card like that shown in Fig. 8 to be filled out. This card is filed, and such cards are so classified by occupations that when a man is wanted for any given department, suitable applications for work in that department are readily referred to. When a vacancy occurs it is filled first; by promotion, if practicable; second, from among those who have previously worked for the company and have left good records; third, by recommendation from any employé of the company whom it is felt would be likely to recommend none but trustworthy and desirable persons; lastly, choice is made from the list of general applications, and in making such

choice the record shown by the card, Fig. 8, constitutes the guide.

About 4,000 of such cards are now on file, and daily applications for work range from 15 to 150 in number, averaging about 70. More than half the applicants

2/1 1896

Employment Department:

It is necessary to employ a hand in my department to do

Trucking

Why necessary? Increase of work

State temporary or indefinite: Indefinite

Chas G Smyth
FOREMAN.

Factory Committee:

We have investigated the above application and recommend the employment of Z T Pease

at the rate of 15 cents per hour.

O. K.—Factory Committee.
By O C Reno

Employment Bureau.
By A S Moore

9-2-'96-1500

Requisition must be duly signed by the Employment Bureau and Factory Committee before men are put to work.

Fig. 9. EMPLOYMENT CARD.

have no trade and ask for anything to do, at any rate of pay.

When an employé is discharged or leaves, a record is kept showing the time and cause, and a statement from the foreman of his department as to whether he would be classified as good, fair or poor. There is a complete record of all ex-employés that have become such since the system was inaugurated, and there is also a complete and detailed record of all present employés.

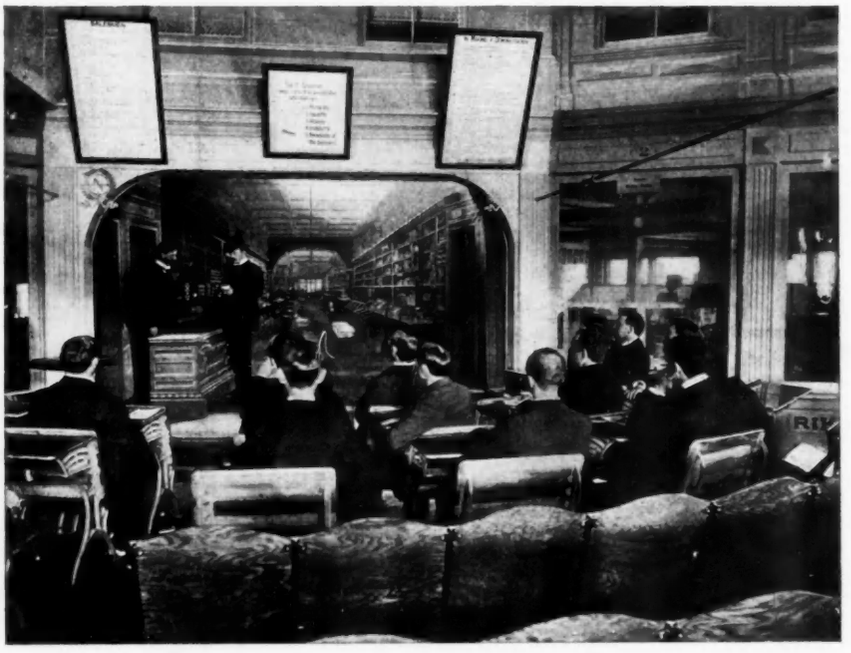
Each employé is represented by a card bearing his name and occupation on one side, and on the other name, number, occupation, time of employment, rate of pay, department employed in, whether he works day work or piece work, and blank spaces for time transferred, time of leaving, cause of leaving and for remarks. These cards are filed in a cabinet and are arranged by departments and numerically.

When a foreman of any department wants additional help he fills out the upper portion of a blank like that shown by Fig. 9 and sends it to the Employment Bureau, which recommends a man for the place at a certain rate of wages; the blank then goes to the Factory Committee, whose chairman O K's it and the man is employed. Suitable blanks are provided for employment, transfer from one department to another, increase of wages, and for leaving the company for any cause; eight of these blank forms in all being used for any given employé who may run the whole gamut of variations; some of them being manifolded, i. e., written in duplicate with carbon paper. By this system nothing of importance is done respecting any employé without a full and complete record which is very easily kept, and enables any required information regarding any employé in any department to be instantly available at the Employment Bureau.

THE SCHOOL—A THEATER.

Perhaps no single department of the establishment is more entirely original or differs more radically from what is to be seen elsewhere, than that which is known as the school. This is for the systematic training of salesmen. It is on an upper floor of the factory and is fitted up as a small auditorium with suitable seats arranged in circular form and a stage; which stage is supplied with properties and scenery by which it can be made to represent the office of a business man, a grocery store, a dry goods store, a department store, a cigar store, etc. Men who are in training to become salesmen come here and stay six weeks at the expense of the company. They sit in this auditorium and see upon the stage a regular drama which shows about how various merchants act and what they say when approached on the subject of the purchase of a cash register; how an experienced and skilled salesman approaches a "P. P." (probable purchaser), what he says and how he says it, how he answers objections and overcomes difficulties. The student is occasionally required to himself to be an actor in such a drama and his rendition of his part is closely watched by competent but always friendly critics who, if need be, offer suggestions or make criticisms.

The space which would be assigned to private boxes in an ordinary theater is here utilized to exhibit various examples of good and bad window dressing for different lines of business, a science which is made a particular study here, with the object of enabling salesmen to make suggestions to customers. Experience shows that the realism given to the teaching of this school by the stage and the "drama of real life" enacted upon it, adds very materially to the value of the training given—makes first-class salesmen of some men who it is thought might not otherwise attain proficiency, and is a help to all of them regardless of previous experience or natural ability.



A REALISTIC DRAMA IN A FACTORY'S THEATER.

The Submarine Torpedo Boat.

The Holland submarine torpedo boat, now approaching completion at the Nixon shipyards, Elizabeth, N. J., cannot fail to be of interest to mechanics in general. As every effort has been made to carry on the construction as secretly as possible, and as the craft is jealously guarded night and day, it is not as yet possible to give a minutely detailed account of this new departure in marine engineering. It is designed to be in fact as well as in name, an actual submarine vessel. While it will usually move about with at least the conning tower above the waves, it will be possible for it, at the will of those in control within it, to sink entirely below the surface, and while submerged and invisible, to approach a doomed vessel and launch the death-dealing torpedo.

The hull of the boat is cigar shaped, 50 feet 3 inches long and 10 feet 3 inches diameter amidships. The shell is of steel, ½-inch thick in the center, gradually reducing to ⅛-inch thick at the ends, with a stiffening frame work within. At the stern is a three bladed propeller wheel 4 feet 9 inches diameter, and forward of that is the rudder, consisting of four blades at right angles and capable of independent movement. There is a foot board extending from end to end on the top of the vessel, and a telescoping conning tower, 2 feet diameter, a little ahead of the middle. These are the only projections from the general symmetrical outline of the vessel. Provision is of course made for discharging the products of combustion when working at the surface. There are three Whitehead torpedo tubes, one horizontal and central forward, one above it inclining upward, and also one aft with an upward inclination. The openings of these tubes are covered with shields when not in use.

The motive power of the craft, except for actual submarine operations, is to be obtained from oil, a large tank of which is located in the bottom. A large storage battery provides the means of operating when entirely submerged. Large storage capacity for compressed air is provided, with a maximum pressure of 3,000 pounds. The air will be used, of course, for operating the torpedos, also for expelling water ballast when it is desired to rise, and for the respiration of the crew, which will never exceed ten men.

The building of the craft is understood to be a strictly private enterprise, and if successful, it may be sold to any purchaser. It would, of course, be an easy matter to duplicate it quite rapidly. There is no apparent mechanical reason why it should not accomplish all that is expected of it.

▲ ▲ ▲

Will some of our friends kindly send us letters received from the Cleveland oil swindlers, with the envelopes in which the letters have been mailed at Cleveland? We have use for some of these envelopes.

Double-Action Cam Press with Knock-Out.

We present herewith some engravings of a press designed for blanking, drawing and forming articles of sheet metal.

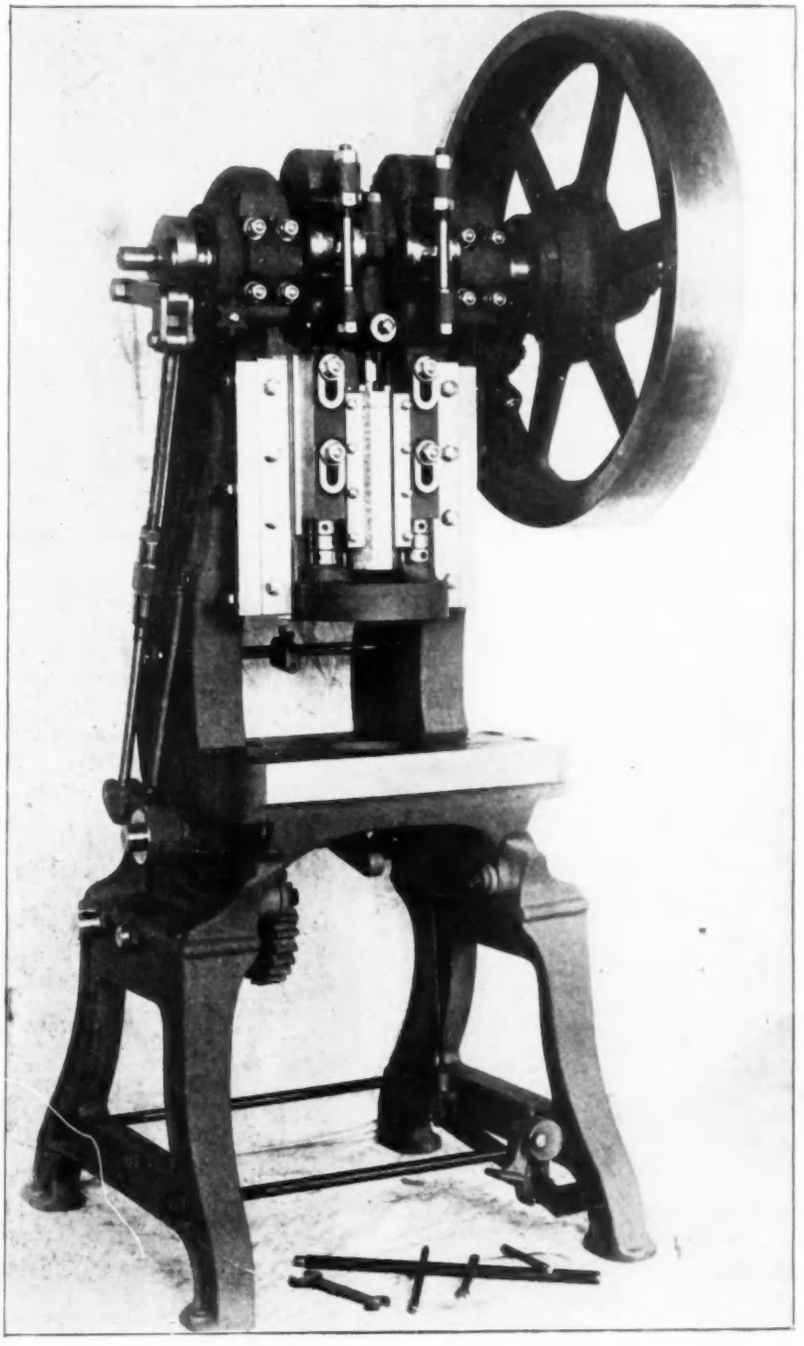
The inner or drawing slide is octagonal in form and is so arranged that wear can be readily taken up and the slide kept in proper working condition.

The outer slide is moved by two cams—one at each side of the central crank, and rollers are placed above and below the cams, with provision for taking up wear by means of the tie-bolts seen in front. The press can be inclined if desired.

At Fig. 2 we give some sketches of some of the mechanism which might not be readily understood without them.

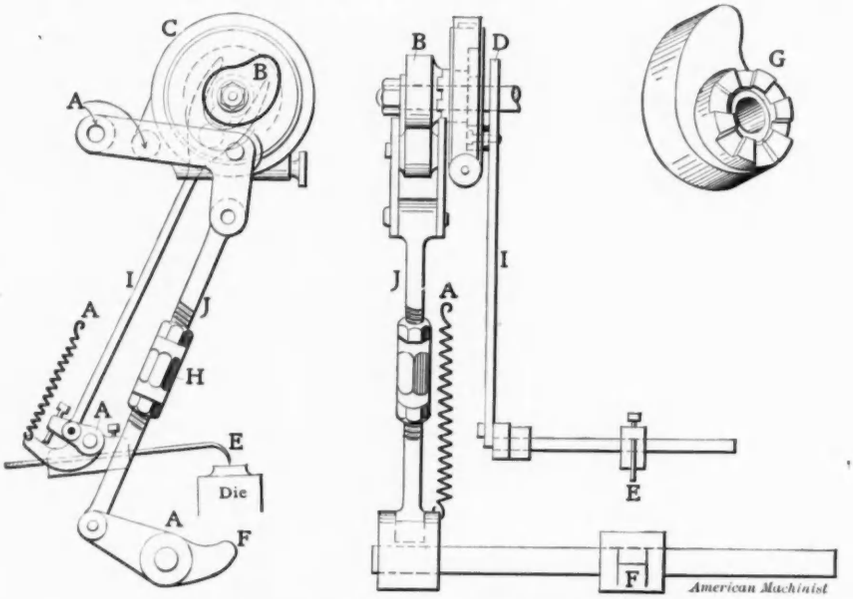
This is the stop or gage, and the knock-out. In the sketches the points marked *A* are those which are fixed to the frame of the machine.

The gage or finger stop *E* is shown resting upon the die. It is supported by a shaft which passes transversely through the machine and outside the frame at the left this shaft carries a crank which is moved by the connection *I*. The crank referred to may be called double, one part of it only is fast to the shaft, the other being loose and carrying the set-screw shown, by which adjustment is effected.



DOUBLE-ACTION CAM PRESS.

This set-screw forces the fixed portion of the crank down and thus raises the point of the gage positively, but it is moved in the other direction only by the helical spring shown, and thus the operator can raise the point of the gage at any time, simply lifting it by hand. This gage controls the movement of stock across the die and a steady pull can be exerted upon a strip of stock which will be held and released at the proper moments and in the proper positions. Motion for this is derived from a face cam which is cut in the inner side of the friction brake disk as indicated.



SKETCH OF KNOCK-OUT AND GAGE MECHANISM.

It is sometimes important to force a blank out of the die as soon as formed and for this the cam *B* gives motion to the connection *J* which, by means of the crank arm shown, moves the arm *F* upward and upon this arm rests any straight piece adapted to enter the die from below and force out the blank.

The machine represents the latest practice in this line of work, and is built by The Stiles & Fladd Press Co., Watertown, N. Y.

▲ ▲ ▲

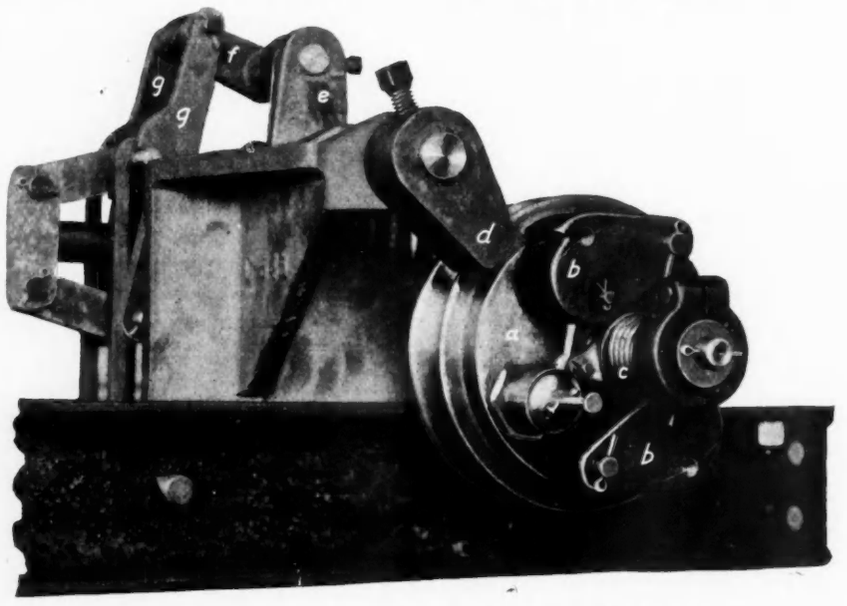
The Safety Governor of the Sprague-Pratt Electric Elevator.

The use of a governor for releasing spring guide-rail gripping devices on elevators, whenever the speed exceeds a certain limit, is, of course, quite common, and a more or less similar application of governors for stopping other machinery whenever the speed becomes excessive is occasionally met. So far as our observation of such devices has extended, all of them, except the one here shown, depend upon the simple pull of the balls at the higher speed for releasing a catch holding a weight or spring, which, when released, actuates the safety stop. The weak point of this arrangement, which will be apparent to any mechanic, is that the catch and its connecting mechanism are only occasionally brought into use, and during long periods of inaction they are liable to become set in their position and require a much greater force to operate them than intended, or than was found necessary under test conditions with everything clean and freshly oiled. Under such circumstances a much higher speed of the governor is necessary to develop the centrifugal force required to operate them than was expected; or it may even happen that they refuse to act at all until such speed has been reached that disaster has already resulted.

In elevator work it is, of course, particularly desirable that the safety stop shall operate as intended, and this has led to the design of the arrangement shown in the accompanying engraving. It is, however, of much wider application than to elevators, and is consequently of interest to all interested in this line of work.

In this device, centrifugal force is not depended upon to actuate the catch, but merely to put the governor balls in a position such that they mechanically engage the catch, when the energy due to the speed of the balls and their attached heavy driving pulley, together with the pull of the driving rope, are available to operate the catch. The principle will be seen to be entirely new, and the operation quite different and much more certain than with the usual construction. There is no friction to resist the movement of the balls, except that of the pins on which they turn, which is so small it may be left out of account. The balls are hence certain to expand at the speed for which they are set, and once expanded, engagement and action are certain.

The arrangement is attached, as shown, to the cross-beam of the elevator—in some cases above the cage, but more usually below it. The grooved pulley will be seen at *a*, being driven by the usual rope, the weights *b b* being mounted directly on the side of the pulley. The weights are held inward at normal speed by the spring *c* coiled around a stud which projects from the center of the pulley. Lugs will be plainly seen upon the outer sides of the weights, these lugs normally revolving just inside the arm *d*. When, however, the balls are expanded by a slight increase of speed, these lugs engage the arm *d*, knocking it sharply to the left. This turns the shaft to which arm *d* is keyed (key not yet inserted in the machine shown), and through arm *e* and link *f*, withdraws the catch *g* from the pin shown, thereby releasing the pin and allowing a powerful spring not shown to act



SAFETY GOVERNOR OF THE SPRAGUE-PRATT ELEVATOR.

through powerful wedges and jaws and grip the guide rail with a force of many tons. Should the first blow fail to trip the catch, it will be followed by others in rapid succession.

Another highly ingenious feature of this device is that it acts only when the elevator is descending. Of course, the balls will fly out at any increase of speed, no matter in which direction the elevator may be moving. The nature of the device permits it to be set for speeds but slightly in excess of the normal, and the balls are hence liable to go out when the car is ascending at a speed slightly above normal, due to an unusually light load, or other cause. It is not, however, desirable to have the grip operate under these conditions, for obvious reasons, and with this governor they will not thus operate, since the balls will then revolve in the direction opposite to that necessary to trip the catch. On the contrary, the arm *d* will be given a series of blows in the direction which will tend to engage the catch more deeply, though it cannot do so, as the catch is so shaped as not to permit it.

▲ ▲ ▲

The Burglar's Use of Electricity.

Lieut. Samuel Rodman, Jr., who in our columns exposed the unsafety of safes, and showed how completely they were at the mercy of the expert burglar and the modern high explosives, has now shown, in the "American Electrician," how the electric current may also be brought into service, how holes are fused through safe walls with astonishing rapidity, and safes may be cracked with greater ease than ever before. He shows how holes were made through 3½ inches of metal in from three to five minutes. Connection may be made by the burglar with an electric-light wire, or a street railway line, or a storage battery in any convenient location may be used, and in addition the kit required is a small and simple affair.

The writer, in his concluding sentences, says: "All safes and vaults as built today—no matter what the make—are reduced to the same level of insecurity; and all alike—manufacturer and banker—will learn, if he so desires, the truth of this statement.

* * * * * *

"Where then shall we find the *prima facie* barrier which shall be infallible, and behind which the vast amount of funds and valuables now so absolutely unprotected shall be perfectly and unfailingly secure? Developments must surely come to meet the existing condition of affairs."

▲ ▲ ▲

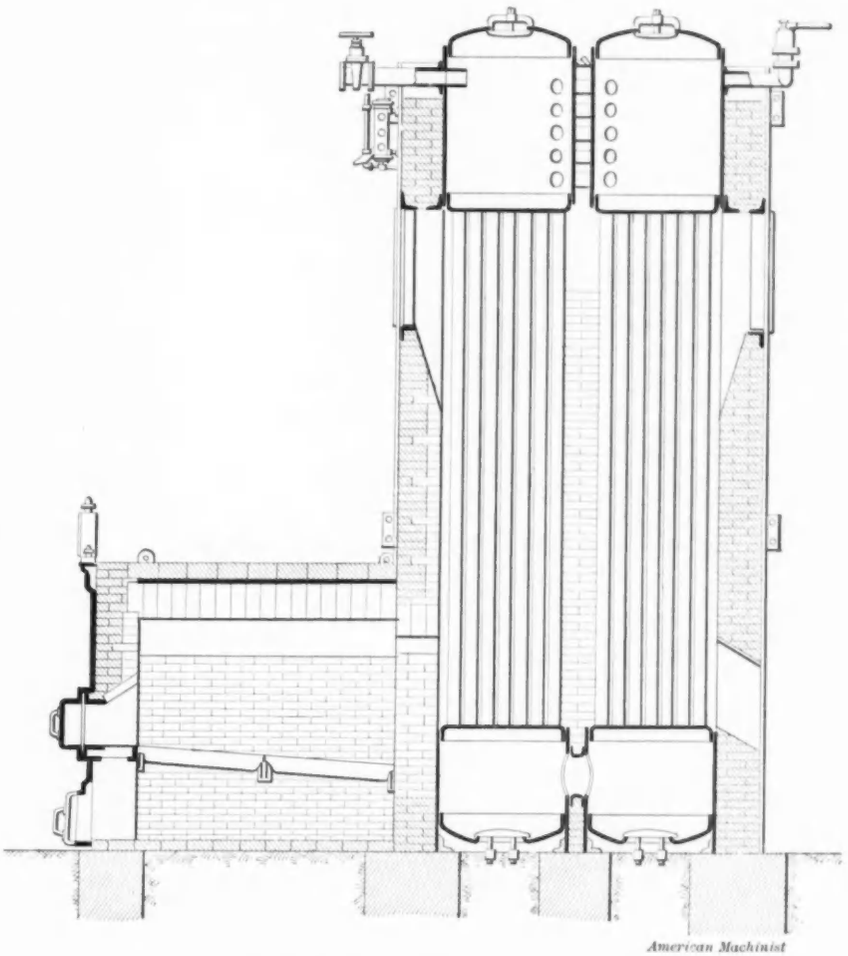
Much of the high-sounding talk regarding the peace-preserving tendencies of modern naval development, seems to be discredited by the disgraceful and outrageous uses to which European naval vessels are at present being put at the island of Crete. If there is no better use for them, the quicker they are destroyed the better.

The Philadelphia Water-Tube Boiler.

The above boiler, built by the Philadelphia Engineering Works, Limited, seems to have a number of interesting features out of the usual run of steam boiler practice. The arrangement adapted is, as will be seen, an extremely simple one, and every important feature is quite clearly shown in the single outline cut herewith.

The initial idea in the designing of this steam generating apparatus evidently has been to secure, first of all, the best possible conditions for the burning of the fuel, so that the greatest amount of heat shall be developed from it. There can be little doubt that over anxiety as to the absorption of the heat by the water has often interfered with thorough and economical combustion. In the present case the furnace or combustion chamber, is entirely outside the walls enclosing the boiler. The boilers are made in pairs, one of each pair standing directly in front of the other with a central transverse wall, not extending to the full hight of the boiler chamber, between them. There are two steam drums above and two mud drums below, connected by a sufficient number of vertical water tubes.

Although the side view which we give of the tubes shows them staggered, so that there is no visible space between them, a transverse section would show that the tubes are arranged in fore and aft rows, so that the spaces between the rows are somewhat wider than the diameter of the tubes. This makes it a simple matter to get at the tubes and to take them out or put them in through the upper openings, closed with doors, in the front and back walls. There are no openings in the side walls. The heated gases from the furnace pass through the brick arches, up the front set of tubes, over the central wall and down the back set of tubes, leaving the chamber and passing to the chimney from the bottom. The drums, both top and bottom, are connected by large cross tubes, which permit a perfectly free circulation of the water. The bottoms of the lower drums and the tops of the upper ones, are spherical with a radius equal to the diameter of the vertical cylindrical portion. The feed water is taken in from the back of the back drum and the steam is taken out from the front of the front drum. The water level is preferably about one quarter of the hight of the upper drum. The tubes in all boilers are 4 inches



THE PHILADELPHIA WATER-TUBE BOILER.

diameter. Twenty sizes of the boiler are now made, ranging in capacity from 60 to 260 horse-power.

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A Table of Cost of Steam Power.

The following interesting and valuable table of the actual cost of steam power under various conditions was embodied in a recent address by Chas. E. Emery, Ph.D., before the Rensselaer Polytechnic Institute, Troy, N. Y., upon "The Electrical Transmission of Energy." The table is given with the author's explanations:

"The accompanying table shows the cost of steam power under conditions differing as to type of engine and amount of power required. There are so many conditions affecting the problem that the subject cannot be fully presented in so small a compass, but the table gives a general idea of the details of the cost of steam power, and shows the approximate costs under conditions to be stated. The calculations are based upon coal at $3 per ton, which will apply to a large number of locations. The table shows that the cost of a horse-power for a working year of 308 days (which excludes Sundays and holidays) and for ten hours per day, is, as shown in column 12, from $75.46 down to $21.38. The latter result can, however, be obtained under experimental conditions. For every hour in the year these prices would become $213 and $61, respectively. The cost of a horse-power for an hour given for the larger engine is 0.69 of a cent. In ordinary practice, with variable power such cost is about one cent per horse-power per hour, or one horse-power hour, as it is called, or $30.80 per year per horse-power continued for ten hours per day and 308 working days in the year. For small engines this cost will be increased to about 2½ cents per horse-power hour, or $77 per horse-power per year. For very small engines the prices will be still higher."

Cost of Steam Power.

1	2	3	4	5	6	7	8	9	10	11	12	13
			Cost per Net Horse-Power.									
	Kind of Engine.	Net Horse Power.	Per Hour for Coal at $3.00 per ton.*	Per Hour for Labor.	Per Hour for Supplies and Repairs.	Per Hour for Sinking Fund, Taxes and Insurance; 5% of total cost added to.		Per Hour for Coal, Labor and Supplies.	Total per Hour.		Total per Year of 3080 Hours	
						5% Interest and Dividends.	10% Int'r'st and Dividends.		For 5% Int'r'st	For 10% Int'r'st	For 5% Int'r'st	For 10% Int'r'st
			Cents.	Cents.	Cents.	Cents.	Cents.	Cents.	Cents.	Cents.	Dolls.	Dolls.
A	Ordinary Non-Condensing	10	.9705	1.00	.28	.1948	.2921	2.25	2.45	2.54	$75.46	$78.31
B	Automatic Cut-off Non-Condensing	75	.5556	.37	.19	.2110	.3165	1.11	1.33	1.43	40.96	44.04
C	Automatic Cut-off Condensing	150	.4239	.25	.14	.1948	.2921	.814	1.01	1.11	31.11	34.19
D	Compound Condensing	250	.3465	.17	.09	.2078	.3117	.607	.815	.919	25.18	28.40
E	Triple Compound Condensing	500	.2697	.11	.08	.2338	.3507	.460	.694	.811	21.38	25.06

*As stated in the text, the coal per hour has been calculated on a conservative basis designed to represent average practice rather than the results possible with apparatus in perfect condition. The basis is 42 pounds of feed water per H. P. per hour for line A, 28 pounds for line B, 22 pounds for line C, 18 pounds for line D, and 14 pounds for line E, and evaporations per pound of coal of 7½ pounds for line A, 8.25 pounds for line B, and 8.5 pounds for the remaining lines. With engines of the kind stated, proportioned for the work and in good condition, the water consumption should be 2 pounds less for each engine, and an evaporation of 9 pounds of water or better per pound of coal could frequently be obtained. As the costs are generally stated for the indicated horse-power, it should be noted that a friction of 10% has been assumed to cover losses not only in the engine, but due to transmission to a jack shaft. For engines running 24 hours per day, the allowance of 10% of the fuel for starting and stopping fires should be decreased. Engines generally keep up their economy for long periods, but the amount of coal is frequently increased by carelessness in connection with the selection of the fuel, the firing, care of the boilers, etc.; so, even if the engines require 2 pounds less water than assumed, the coal required generally costs fully as much as stated.

▲ ▲ ▲

Letters from Practical Men.

Balancing Reciprocating Parts of High-Speed Engines.

Editor American Machinist:

I have read with the greatest interest the letters of Mr. Griffin in your issue of January 21st and of Mr. Porter in that of February 11th, on the above subject.

Indeed, the sight of a letter written by Charles T. Porter brought back the remembrance of the pleasure with which, more than twenty years ago, I first read his intensely absorbing demonstration of the effect of the inertia of the reciprocating parts on the pressure exerted on the crank-pin. To many thousands of engineers of all nations, the perusal of that argument has been an intellectual treat.

It is now clear that, as Mr. Griffin has stated and Mr. Porter has confirmed, the inertia should absorb *at least all* the steam pressure at the commencement of the stroke, to ensure silent running. Mr. Porter is right in supposing that the rank and file would be curious to know why he, the great leader, did not adopt this method in the Porter-Allen engine; and his reasons, given in your issue of February 11th, are most instructive and interesting.

Putting aside the vexatious question of clearance, which affects only the economy of steam, and confining ourselves solely to the balance of the engine, we see that he has no objection to vertical vibrations, either in the horizontal or vertical engine, but seeks to avoid horizontal vibrations. While all will agree that the horizontal vibrations are the more serious, no one will object to a system of balancing which obviates both.

Next we see that he could not wholly counterbalance the reciprocating parts horizontally, *because his engine had a single crank disk*. That is, if I correctly read between the lines (and of course I am open to correction), because the balance-weight was not in the center-line of the engine, and therefore a horizontal couple was produced, which was reversed twice in every revolution.

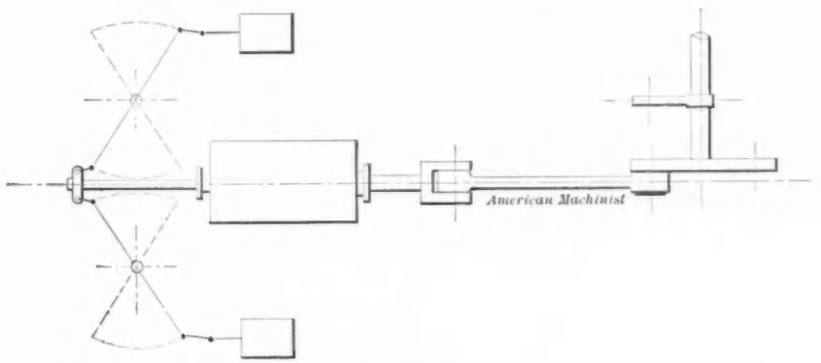
Mr. Porter does not allude to the fact that the horizontal effect of the revolving counterweight is the same on both centers, while, with a finite connecting-rod, that of the reciprocating parts is greater on the near than on the far center. We know he is fully aware of this, because in his book on the indicator, he has taught it

to us all. But supposing this difference to be a minor matter, it would be as well to have a system in which the balance was absolute.

Now seeing the frank and candid manner in which Mr. Porter has owned his difficulties with the Porter-Allen engine, and his admission that things have advanced since the time to which he refers, I venture to put forward an argument to show:

First—That even at the speed adopted by Mr. Porter the pressure on the crank-pin can be relieved to a far greater extent than he achieved.

Second—That both the horizontal and



BALANCING RECIPROCATING PARTS OF HIGH-SPEED ENGINES.

vertical vibrations can be perfectly balanced; and that even the obliquity of the connecting-rod need not introduce a want of balance.

Third—That this can be done even with a single crank engine, it being possible to counteract the couple produced by the non-coincidence of the planes of motion of the crank-pin and counterweight.

Now I maintain that the only perfect way of balancing is to balance reciprocating weights by reciprocating weights, and revolving weights by revolving weights. If you balance a reciprocating weight by a revolving one, you introduce an unbalanced vibration at right angles to the one you have succeeded in suppressing. Therefore I would arrange an engine as shown in the figure.

A small cross-head attached to the tail piston rod and jointed by links to two beams, rocking about their centers, the outer ends of which are similarly jointed to two weights guided to move parallel to the piston. These weights are equal and their sum is equal to the reciprocating weights, in which is included a fraction of the weight of the connecting rod, which, for brevity, I will call half, but which may be obtained thus:

Place the rod in a horizontal position with its ends resting on two weighing machines, the supports being exactly under the centers of the small end and big end brasses, respectively. Then the weight registered by the machine supporting the small end must be included in the purely reciprocating weights, while the remainder must be considered as revolving with the crank-pin. Of course one weighing machine will suffice.

In a double crank engine the revolving weights (i. e., the crank-pin and half the connecting-rod) will be balanced by equal weights on each crank, the sum of their moments being equal to the moment of the revolving weights.

Then I think it will be admitted that:

First—The inertia of all the reciprocating parts, with their links and beams, and the consequent reduction of pressure on the crank-pin, is more than double that of an engine without the reciprocating balance weights.

Second—Both horizontal and vertical vibrations are suppressed, whatever be the length of the connecting-rod.

Next we come to Thirdly, the case of a single crank engine. How are we to balance the revolving weight; how bring the counterbalance into the plane of motion of the crank-pin and connecting-rod? Why, simply by employing the difference instead of the sum of two moments, to counteract the moment of the crank-pin, etc. That is, let the main counterbalance, opposite the crank-pin, more than balance it, and restore the balance by a subsidiary counterbalance in the same direction as the crank-pin farther along the shaft, placed so that the resultant of the centrifugal forces of the two counterbalances is not only equal to that of the crank-pin, etc., but lies in the same plane. Thus let the moment of the crank-pin and half the connecting-rod be represented by the figure 3; make the main counterbalance 4, and the subsidiary 1: placing the latter 3 times as far from the main counterbalance as the crank-pin is, measured along the shaft. Then these three parallel forces balance.

I hope someone will put this to the test; it could be tried on an existing engine without great expense. I am too busy to try it myself. I trust, at any rate, that the above suggestion may interest some of your readers. C. A. MATTHEY.

Glasgow, Scotland.

Allowance for Press Fits.

Editor American Machinist:

In reading your article in issue of January 28th on fits, I am inclined to think that you are a little wrong. Having, as I have had and still have, considerable practice in that line of work, axle and wheel fitting, I will give what I find about the thing in fitting wrought iron shafts to cast iron hubs, from 4 to 8 inches diameter:

Diam.	Allow.	Pressure will be
4 inches	$\frac{9}{1000}$	25 to 30 tons.
5 "	$\frac{10}{1000}$	30 to 35 "
6 "	$\frac{13}{1000}$	40 to 45 "
7 "	$\frac{17}{1000}$	50 to 55 "
8 "	$\frac{21}{1000}$	65 to 70 "

This is when the fits are from 6½ to 7½ inches long. To be sure, iron will vary some; but you will find that making the allowance I have given is about the thing, take one with another. In fitting an axle to a steel hub, 5 in. bore, 5-1000 I find is enough to get 35 or 40 tons pressure. I have found this out by experience. If there are others that don't think I am right, would like to hear from them.

EXPERIENCE.

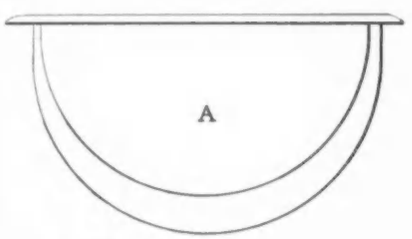
[We are glad to receive, and would gladly receive more, such statements of actual practice. Their evidence is of course incontrovertible.——Ed.]

▲ ▲ ▲

Calipering a Kettle—A Handy Drafting Set.

Editor American Machinist:

Having been recently called upon to test and examine a pair of cast-iron or gun-metal kettles, it became necessary to determine approximately the thickness of the metal. This was quickly done, as shown in Fig. 1, *a* representing the ket-



tle, and *b* an improvised calipering instrument. Upon the ground, near the kettle, lay several pieces of board, four of which were selected and placed as shown at *b*. The two short pieces were nailed solidly to one of the long pieces, and a single nail to the other, at *c*, served to hold *a* and *b* firmly in place. With the tool completed as above, it was placed upon a kettle, one leg being inside, the other outside thereof. The free ends of the boards were brought together upon the metal forming the kettle, close to the top. A mark was then made at *a*, fair with the movable leg of the caliper *c*. The instrument was then pushed further down towards the bottom of the kettle, and another mark made upon *a*, parallel with the side *c*. Half-a-dozen measurements

were made as above, both at the top and bottom of the kettle; then the instrument was removed, and the movable arm being placed fair with the marks scored, the thickness of the kettle at any given point could be measured direct. The tool was crude, but it did the work in a very good fashion.

A handy T-square has been carried a couple of years in my pocket, together with a small pair of compasses and a 2-inch 60 and 30 degree triangle. Fig. 2 is

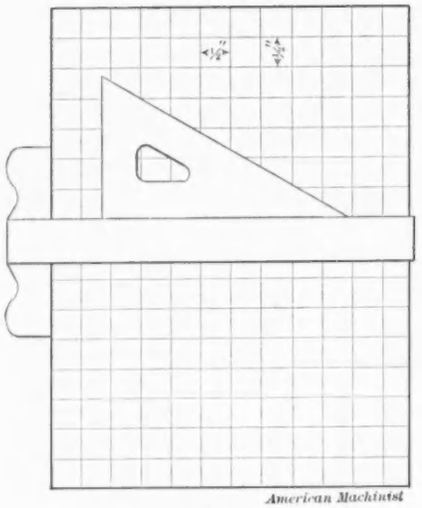


Fig. 2

the T-square. The head is 3 inches long and the blade 6 inches. The square is composed of two pieces of maple glued together, and fastened in no other way. It is not necessary that T-squares should be exactly square; that is, that the head should form an angle of 90 degrees with the blade. Instead of this, the head may be considerably out of square and do no particular harm. Really, the T-square is only a parallel ruler for the draftsman. Only straight lines are drawn to it, and under no circumstances should a T-square be reversed and put on crosswise of the board for perpendicular lines. Use a triangle for this, and don't abuse time and labor by trying to get the blade of a T-square exactly square with the head.

My pocket drawing-set consists of a pad of cross-section paper, having the section lines drawn about ½ inch apart. These pads come about ½ inch thick, and they make excellent drawing boards until they are worn down very thin, when they may be reinforced by placing the nearly used portion on top of another partly used pad and securing it thereto with a little mucilage. The triangle shown in this drawing is a 30-degree and 60-degree, about 2¼ inches by 4 inches, as may be noted by looking at the section lines. With the addition of a pocket-case containing a small pair of compasses, a good deal of very accurate sketching may be done during leisure moments.

JAMES F. HOBART.

Helping the Crank Over the Center.

Editor American Machinist:

Perhaps I may be allowed to remark that the inventor of that help-her-over-the-center device, in your issue of February 18th, was aparently in too much of a hurry to finish his invention. It certainly could be made to show itself to better advantage than in the cuts given. Referring to Fig. 4, if you will kindly reproduce it, calling it here Fig. 1, the dotted lines which I have added will show that while the air is compressed, as it was assumed to be, in the left-hand cylinder, and its piston has therefore more lifting

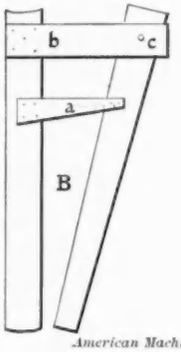


Fig. 1

power than the other, its leverage is reduced so that its apparent advantage is lost. Now, the location of the eyes might be changed so that this would not occur, and the lifting piston might have the advantage of leverage as well as of pressure. If the eyes were placed as indicated by the dotted lines, it will be seen that the leverages would be very different and more satisfactory. This construction would change the shape of the connecting rod, which would be a simple matter, but the interference with the crosshead would be more serious. This also could be got along with by means of a bifurcated rod straddling the interfering parts, or some similar device.

Another point worth thinking of is, that in the arrangement as shown, the entire device is suspended from the cross-head, thus giving all that weight for it to carry in addition to the downward thrust of the rod. If the vibrating arm were pivoted upon a fixed pin at *A*, Fig. 2, and the central arm were round and telescoped, the upper part which connects with the crosshead sliding over the lower part which swings upon the fixed pin below, then the pressure in both the air cylinders would have a lifting effect upon the crosshead, and so tend to reduce its working friction, instead of increasing it. This arrangement is sufficiently shown in the sketch.

MORRIS FULTON.

Philadelphia.

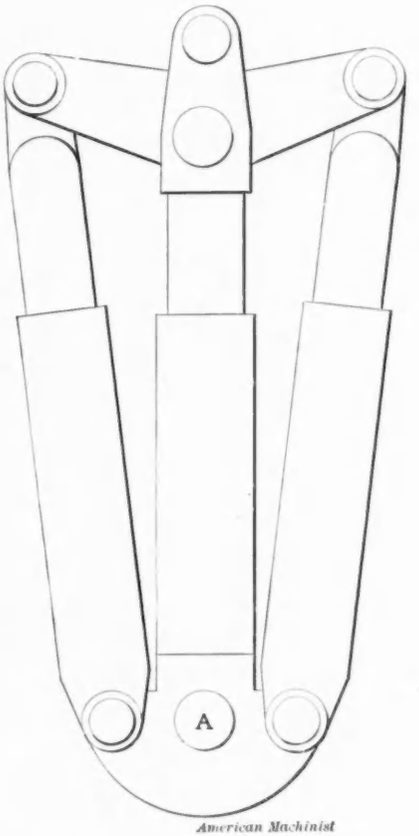


Fig. 2

LIFTING THE CROSS-HEAD.

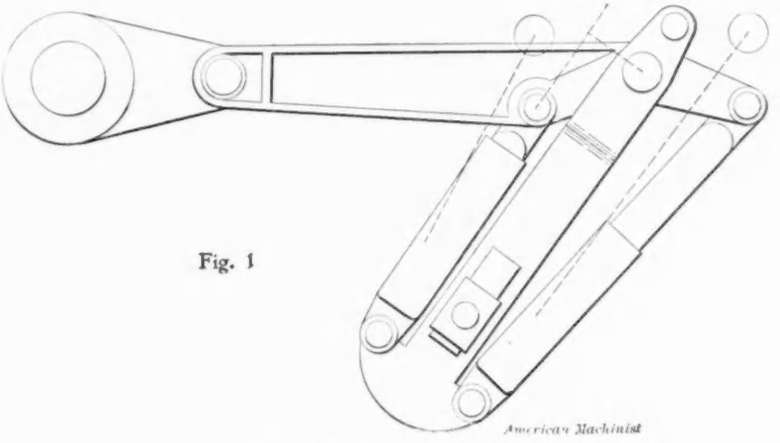


Fig. 1

CHANGING THE LEVERAGE.

Weight of Reciprocating Parts of High-Speed Engines.

Editor American Machinist:

In your issue of January 21st, Mr. Griffin has raised a question as to the correctness of the usual method of proportioning the reciprocating parts of steam engines, for the purpose of equalizing the pressure throughout the stroke.

It seems to me that his argument is defective in some points; at any rate, I have constructed a pair of diagrams, Figs. 1 and 2, showing steam expansion and compression curves, combined with diagrams of acceleration forces, forward and return stroke. The point of cut-off was chosen at one-sixteenth of the stroke, and a clearance of 7 per cent. The initial pressure is 100 pounds, gage, and back pressure 2 pounds. The ratio of crank to connecting rod is $\frac{1}{6}$. The average value of the acceleration force at the beginning of the stroke is equal to the initial steam pressure, or 100 pounds per square inch. Therefore, at the beginning of the forward stroke, with the ratio of crank to connecting rod chosen, the acceleration force is $\frac{7}{6} \times 100 = 116$ pounds per square inch, while at the beginning of the return stroke it is 83 pounds.

An inspection of the diagram for the forward stroke shows that at the beginning of the stroke the pressure on the crank pin is opposite to the direction of the stroke, and the reciprocating parts are being dragged forward. This condition continues up to the point *B*.

The diagram for return stroke shows a positive forward pressure between points *A* and *B*, but at *B* there is an abrupt reversal of pressure, and the pressure is again reversed at *C*. Assuming dimensions of cylinder equal to 14 x 16 inches, and 250 revolutions per minute, the weight of reciprocating parts necessary to give this accelerating force is 1,083 pounds.

It seems to me that this excessive weight, together with the reversals of pressure when cutting off at a very early point constitute two serious objections.

Figs. 3 and 4 show the same diagrams as Figs. 1 and 2, but with a mean accelerating force at the beginning of the stroke of 30 pounds instead of 100 pounds, corresponding to a total weight of 325 pounds.

It will be seen from an inspection of these diagrams that the pressure upon the crosshead pin reduces to zero at *A*, owing to compression, and that during the remainder of the stroke there is an increasing pressure in the opposite direction, which equals *B C* at the end of the stroke if the valve has lead. It will be seen that this final pressure at the end of the stroke is approximately equal to the initial pressure at the beginning of the succeeding stroke. The reversal of pressure takes place, not at the end of the stroke, but just previous to it, at *A*, and the pressure in the opposite direction is not applied instantaneously, but gradually, the distance *A B* corresponding to a movement of the crank of 38 degrees for the forward and 27 degrees for the return stroke. The broken lines show the distribution of pressures corresponding to a cut-off of one-fourth stroke. For this cut-off the heavier weight shows to better advantage, while for the lighter weight the reversal of pressure takes place at *A*, much nearer the end of the stroke.

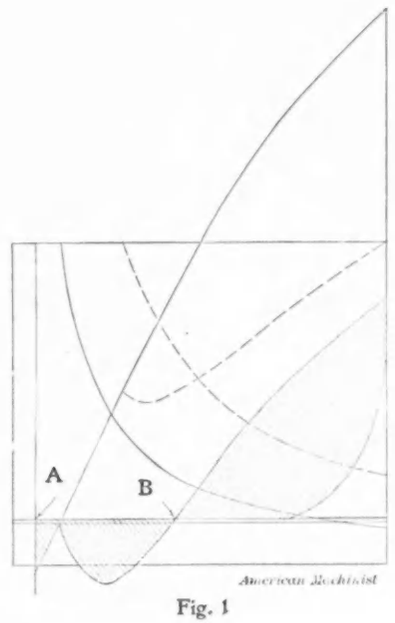


Fig. 1

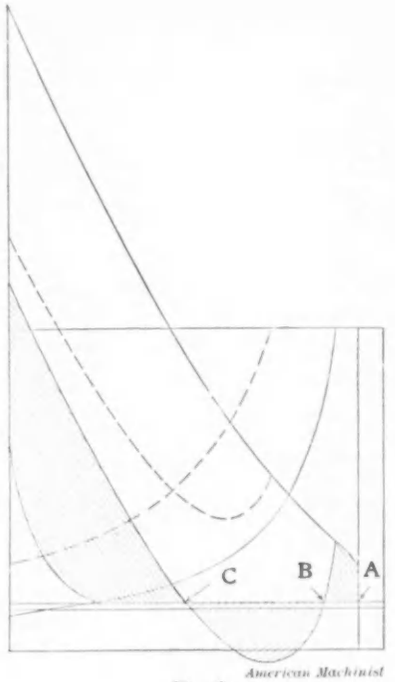


Fig. 2

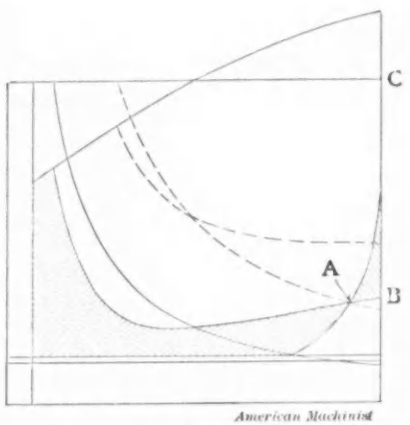


Fig. 3

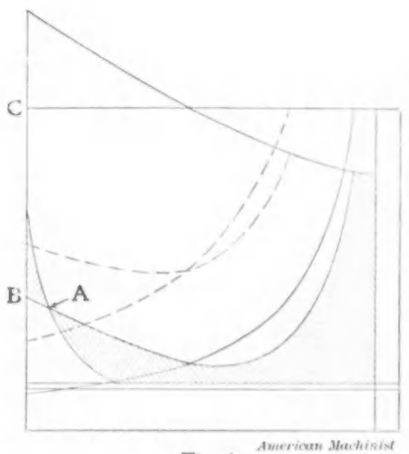


Fig. 4

WEIGHT OF RECIPROCATING PARTS OF ENGINES.

ARTHUR L. WESTCOTT.

Agricultural College, Mich.

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Formula for Line Shaft Collars.

Editor American Machinist:

In a recent issue of your paper, I noticed an article on sizes of shafting or set collars. I was surprised that such firms as replied to this inquiry had no formula for making collars. Below I give one which I have found satisfactory, and which makes a well-proportioned collar:

V = diameter shaft;

$\frac{V}{2} + V + \frac{1}{4}$" = outside diameter;

$\frac{V}{5} \times 4$ = width.

EXAMPLE:

2" shaft, $\frac{2}{2} + 2 + \frac{1}{4} = 3\frac{1}{4}$ outside diameter	6" shaft $9\frac{1}{4}$" outside diameter.
2" shaft, $\frac{2}{5} \times 4 = 1.6$ width.	6" shaft 4.8" width.

C. E. FAWCETT.

Cedar Rapids, Ia.

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Mr. F. Schrader, superintendent of the Liberty Cycle Company's Works at Bridgeport, Conn., writes us that the works at Rockaway, N. J., in which a tank explosion occurred a short time ago, cannot properly be now called the Liberty Cycle Works, as they are occupied by the Cycle Components Company. We suppose the error arose from the fact that the works at Rockaway are still locally known as the Liberty Cycle Works.

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The City Factory Building.

Much is being said continually of the growth and development of the tall office buildings in the large cities, and much speculation is indulged in as to the ultimate results that may follow their general establishment. It is, no doubt, necessary and proper to limit these buildings, as to hight and other particulars, within reasonable bounds, and when this is done, it must be conceded, certainly by those most familiar with them, that the new office buildings are a great success. They concentrate business and greatly facilitate its transaction. Those who occupy them were never so comfortably, so safely, or so healthily situated.

Much less has been said, and much less seems to be generally known, of the simultaneous growth in our large cities of buildings intended for an entirely different purpose. Buildings of the highest class, architecturally, are being erected, merely as a means of reasonably profitable investment, and with the design in view of their exclusive use for manufacturing purposes. They are designed not merely for light manufacturing, but for the heaviest. Rooms of any size may be secured in these buildings, or entire floors, or whole buildings, with any amount of power that may be desired, with electric lights, heat, water and elevator service. Manufacturing firms are going into these buildings, not as a makeshift or as a temporary arrangement, but with the full intention and expectation of permanent establishment. The Garvin Machine Works, of New York, when they were burned out a year ago, found nearing completion a typical city manufacturing building, the property of the vastly wealthy Trinity Corporation, and were enabled to secure the entire building upon a long lease. Some other buildings of the same type may have a dozen or a score of occupants, all absolutely independent of each other, and each provided with just the facilities that it needs.

These buildings, with the facilities they offer, cannot fail to have a powerful influence in promoting the development of small manufacturing enterprises. They not only make it easy for such concerns to make a start, but they can also live and grow and still find accommodation. If an ambitious young machinist wants to make a start in a small way, he needs only his tools, and need not trouble himself about providing a power plant. If any specialty is to be manufactured, the precise machinery for that product is all that is required. If the business grows, as it must to live, there are possibilities of almost unlimited expansion simultaneous with the growth.

As these investment buildings compete with other lines of investment, the profits to be realized from them will ultimately, if they do not now, range low, so that the service they render to the tenants is usually cheaper than they individually could provide for themselves. This is especially true of the power supplied, both the generation of the power and the cost of attendance being much smaller for the larger installation than would be possible for a number of smaller and isolated units. The factory building, equally with the office building, realizes the benefit of the cheaper construction possible under the modern methods. It is quite possible that the modern city building, exclusive'y for manufacturing purposes, may prove as great a success as the modern office building.

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Iron Rust.

It is no news that iron and steel will rust. That, if iron and steel are used for building purposes, the buildings may be expected to weaken to the danger point, if not to tumble down, in the course of two or three generations is, however, somewhat newsy. A note of alarm of this character has been sounded, and paragraphs in the same line are in all the papers. We are told that it is difficult, if not impossible, to find any rustless coatings for iron or steel, and that, therefore, they are steadily and rapidly rusting away before our eyes, or, more correctly, the process is going on, hidden in the walls of our modern buildings.

Now, this is undoubtedly a false alarm. The lamp-post on the corner reassures us. No police officer requires a certificate of its age before he ventures to recline against it. There is no need of alarm about our buildings, so far as their rusting away is concerned. They will probably stand safely as long as it will be desirable to have them stand. When we see how our business buildings are pulled down and built up again, over and over, it can scarcely be believed that even those now going up are to stand forever. We venture to predict that, when they do come down, they will not be rusted down.

As an argument by which to justify the alarming proposition referred to, it has been stated that when the "New York Times" building in this city was pulled down a few years ago, the iron beams of it, after less than forty years of service, were so eaten by rust as to be even then in a dangerous condition. The actual fact, upon the testimony of the owners, was that the beams referred to were in excellent condition, and were used again in the new building, so that a reference to this case gives us a positive assurance of safety instead of the reverse. Those longest and most intimately familiar with iron and steel, and their lasting qualities when no special efforts are made to preserve them, can afford to treat lightly the tales of the alarmists as to their ephemeral existence, especially when the accumulated knowledge of the years is challenged to preserve them.

There are conditions under which the corrosion of iron and steel goes on rapidly, and here, curiously enough, rust seems to assume a beneficent aspect. If rust is bad, it is not all bad. The most active rusting going on, that we know anything about, is in the warships of the world. Rust does not seem to be nearly so active in the merchant marine. It eats away millions of dollars of value, or at least of cost, in Uncle Sam's little fleet every year, notwithstanding other millions of dollars spent in continually scraping off the rust and repainting. This is where the beneficent function of the rust comes in. If the ships did not rust out so that we could keep on replacing them, we certainly could not keep in fashion, and if fashion is anywhere imperative it is certainly in ships of war. We are not in the swim if we are not in the fashion in armor and equipment, and rustless coatings could only be inimical to safety, and their employment could only be at the suggestion of an enemy.

Foreign Postage.

A valued correspondent points out that our note of March 11th on insufficiently paid foreign mail matter, failed to call attention to the difference in the unit of weight for domestic and foreign mails. With domestic letters a single rate of two cents is collected for each ounce or fraction thereof, whereas with foreign letters a single rate of five cents is required for each half ounce or fraction thereof, so that a letter weighing ¾ ounce which would go for a single domestic rate, would require two foreign rates, or ten cents. Moreover, the amount collected on insufficiently paid matter is double the deficiency—that is to say, a ¾-ounce letter with only a five-cent stamp affixed would be charged with ten cents on its delivery.

A domestic postal card (one cent) will be transmitted to foreign countries fully paid if it have an additional one-cent stamp affixed, or if mailed without such stamp, it will be transmitted, but subject to the collection of double the deficiency, or two cents, on delivery. This information is official from the postmaster of this city. It applies, of course, to countries within the postal union only.

The one-ounce unit of weight for domestic matter has led to the general use of heavy paper here, and no doubt this is the cause of much of the difficulty—many letters which would here go for a single rate requiring two rates if they are to be sent abroad. It would seem to be excellent sense to use thinner paper for foreign letters, as is universal in Europe.

▲ ▲ ▲

Technical Books.

Scarcely any identical question oftener reaches the editorial desk of the "American Machinist" than the one which asks if "Mr. J. G. A. Meyer's articles on mechanical drawing are to be published in book form, and if so, when." We have just received Parts 1 and 2 of this work, which is to be published in 24 parts, one of which is expected each month hereafter until completion. The author has devoted himself almost exclusively to the work of preparation for the past eighteen months, and has found it advisable to rewrite the entire series and make new engravings. Our readers need scarcely be informed that this work has been done in the most thorough and conscientious manner—its author is incapable of doing work in any other way. His skill as a draftsman is also clearly shown by the engravings, which are not the result nor examples of engravers' art, but of the authors' skill and long practical experience at the drawing board. Every engraving is new, has been made for this book, is an exact mechanical reproduction of Mr. Meyer's personal work, and will show to the student precisely how every line is made by an experienced and skilled man. The first number, which introduces the subject and treats of the general broad principles underlying the art of drawing, contains beautifully executed and complete working drawings of a modern engine lathe, and it is evident from this that the drawings alone are likely to prove well worth the cost of the books. The second number treats of the instruments, their care and methods of use; introduces the subject of drawing the various geometric figures most used in machine drawing, and the text is fully explanatory of every step taken. Mechanically—i. e., as regards paper, typography, etc.—the books are elegantly gotten up, and there can be no doubt that many students of the art of mechanical drawing, both young and old, will find them an invaluable assistance. The parts before us contain 36 and 32 pages, respectively, 10 x 14 inches, with margins wide enough to permit trimming to standard 9 x 12 inches, if thought desirable. The numbers are designed to be sold by subscription at 50 cents each, and are published by the Arnold Publishing House, 16 Thomas street, New York.

▲ ▲ ▲

Fine Points in Lubrication.

Some weeks ago we noticed a book entitled "Friction, Lubrication and the Lubricants in Horology." This book is a treatise on oils and on the methods of designing pivots for clocks and watches with a view of securing effective lubrication, as well as long life and retention of the oil in the bearings. Some of the methods employed are refinements which would strike a machinist as rather fine haired, but they are given in all seriousness, and we take it to represent the established practice of watchmakers. We reproduce two engravings from the book, which we think will interest our readers, as illustrations of refinements with which machine constructors generally are not acquainted.

The two forces to be considered by the watchmaker in so designing a pivot that the oil shall remain where it is wanted, are capillary attraction and the attraction which all bodies have for one another, which between the earth and another body we call gravity.

Fig. 1 is a section of a watch pivot bearing, and we are seriously told that:

1. The oil-sink *O* is made deep and narrow, because capillary attraction is greater between surfaces near together than between those farther apart; a narrow sink thus increasing the hold of the bearing on the oil.

2. The shoulder is beveled off at *P* to make a similar use of capillary attraction, since by this construction the tendency is to keep the oil at the center instead of encouraging it to spread over the shoulder bearing.

3. The boss *B*, the back taper *T* and the groove *G*, are provided, in order to remove metal which, if present would by gravitational attraction tend to draw the oil away from the bearing.

Fig. 2 shows a section of the balance wheel jewelled bearing, in connection with which we are told that the hole jewel is made convex above so that capillary attraction shall draw the oil to the center and counteract the tendency of the surrounding parts to attract it away from the bearing. Meanwhile the sides *a a'* of the jewel settings are cut back, and the back taper *T* is made for the reason explained above. In oiling this bearing, the author insists that the oil should never be allowed to touch the setting, because if it once reaches the joint *b*, the capillary attraction of that joint will soon draw the oil from the bearing.

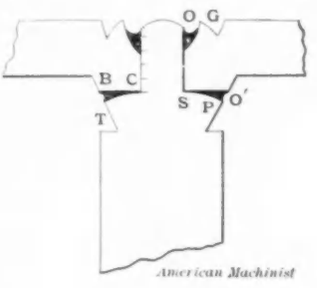

Fig. 1

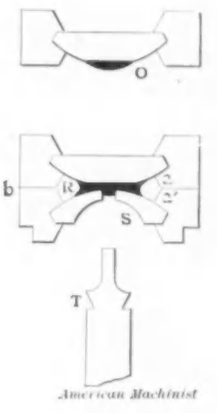

Fig. 2

FINE POINTS IN LUBRICATION.

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It is reported that the United States Government, upon the advice of Capt. W. T. Sampson, Chief of the Bureau of Ordnance of the Navy Department, has bought outright the Sponsel rapid-fire gun patent for fifteen thousand dollars. It is understood that this is done as a protection against the prospective demands of the American Ordnance Company, which controls the Driggs-Shroeder, the Dashiell, the Hotchkiss and other rapid-fire gun devices.

The steamer "Kasbec" a few days ago towed into the port of New York the long-missing ship "T. F. Oakes," which she picked up in a perfectly helpless condition, many of the crew having died and the rest being sick in their berths. In getting the hawser aboard for the tow, the line fouled the propeller of the steamer and wound around between the hub and the stern post, finally blocking the shaft so that the engine could not be turned either ahead or astern. The engineer uncoupled the shaft at the after coupling and blocked it apart with wooden liners an inch thick, thus lengthening the shaft that amount, and the screw was then enabled to turn. The daily papers, of course, told the story that the engineer rigged up a wooden shaft with which he brought the vessel in.

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Commercial Review.

NEW YORK, SATURDAY EVENING, MARCH 27TH.

STEAM POWER MACHINERY.

In the short interval which has elapsed since our last report upon this subject, the change which has taken place in the general status of the engine business has been slight. At that time, four weeks ago, the market had not begun to move; so it is hardly to be supposed that by this time the volume of trade could be very large. Few sales of any size are reported by sellers in this quarter, and it must be acknowledged that a period of substantially improved trade has not yet set in.

But yet it seems that the undertone of the market is more hopeful, that its atmosphere is more exhilarating, and that its position is stronger. These qualities are, it is true, experienced in a very mild degree, and when we remarked their seeming existence to a member of a leading engine company he replied that our statement was the best news he had heard; yet we are persuaded that they are, in some measure, a fact. The advancing season is bringing with it more show of business in the shape of inquiries. Of course this is but natural, and the increase is not all that might be expected.

A source of demand which now is somewhat in evidence, is found in electric railways. It was noted some time ago that projects for some new underground conduit trolley systems had materialized in this city, the contracts for the electrical machinery having been let; and there are others from which the engine and boiler, as well as the electrical, people may soon derive benefit. One or two parties see improvement in the demand from industrial sources, though as yet we are reluctant to say that anything to boast of has taken place in that line. It is generally believed, and undoubtedly with justice, that business in the West is stagnant; yet the Weston Engine Company, Painted Post, N. Y., inform us that out of eight engines for which orders have been taken by them within a week past, six are for the West; the distribution being as follows: Chicago, three; Ohio, two, and Detroit, Philadelphia and Brooklyn, one each.

As to the demand from the local building trade, contracts for heating and lighting goods have recently been placed for an important addition to the Standard Oil Company's building, on lower Broadway. Three Ames engines, driving, by direct connection, Crocker-Wheeler dynamos, with Harrison feed-water heater, are included in the plant, as we are informed by Evans, Almirall & Co., who do the high-pressure piping, etc., and also that for the Borgfeldt building, on Worcester street, in which four Delaney boilers, a Berryman heater, etc., will be used.

Certain pump companies are reporting improved conditions. One states as follows: "For quite a while past a gradual improvement has been experienced by us. Within a couple of weeks this has de-

(Continued on page 35.)

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Business Specials.

Gear wheels, gear cutting. Grant; see page 16.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Ct.

Engine Castings ¼ to 2 H. P. Finished boilers and engines. Grant Sipp, Paterson, N. J.

Send $1 to the Tabor Mfg. Co., Elizabeth, N. J., for improved stop-motion revolution counter.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

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Wants.

Situations and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday Morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Situations Wanted.

Mech. dftmn. dsrs. pos.; 12 yrs. exp. 147 AM. MACH.

Capable young designer and dftmn., 3 yrs office, 8 yrs. shop exp., desires pos. Box 150, AM. MACH.

Tool maker, also gig work, used to micrometer measurements, management of milling and grinding machines. Box 144, AMERICAN MACHINIST.

Sober and reliable pattern maker desires a change of position. A1 on match boards; married; location immaterial. Box 145, AMER. MACHINIST.

Draftsman wants situation; machine shop, pattern shop and drafting room experience; good references; good habits. Box 146, AMER. MACHINIST.

Mechanical draftsman having extensive exp. in designing marine, stationary high speed engs. and dredging machy. wants pos. Box 143, AM. MACH.

Wanted—Position as machine shop supt. or foreman by thorough practical mechanic; steady and reliable, with wide experience in managing men to best advantage. Address, Box 148, AM. MACH.

English Trade—Engineer and salesman (now in New York) well known in Great Britain, wishes to represent American mfr. of specialties in tools or machines; comsn. or salary. Box 142, AM. MACH.

Double entry bookkeeper, stenographer or traveling-salesman desires pos. Can furnish first class recomdtns. as having served in above capacities. Nine years office exp. Address Clerical, AM. MACH.

Competent draftsman, 12 years exp., good designer of spcl. machy., etc., a patient worker on difficult problems, with ability in overcoming engrng. difficulties, seeks pos. Designer, care AM. MACH.

A skilled designer and builder of special machy. is open for engagement; many yrs. exp. in originating and perfecting automatic machy. and improving mfg. processes; highest ref., covering entire record. Address Box 65, AMER. MACHINIST.

Situation wanted by electrical and mechanical expert who can design and superintend construction of high grade direct current elec. apparatus; can take full charge production and keep cost at min.; at present supt. of stm. eng. and machy. mfg. co. employing over 75 men; 10 yrs. exp. Box 152, AM. MACH.

Help Wanted.

Help Wanted—Good pay for leisure hours. Geo. W. Lord, Philadelphia, Pa.

Wanted—First-class tool maker, one used to die work. Apply, Ridgway Dynamo & Engine Co., Ridgway, Pa.

Wanted—Good all-around mechanic as machinist and pattern maker. Good position for the right man. Address, M. P., AMERICAN MACHINIST.

Wanted—Foreman brass moulder with thorough knowledge mod. fdy. requirements. Give experience, age and wages expected. Box 141, AM. MACH.

Wanted—A rapid and accurate detail draftsman and tracer. Address Robert W. Boenig, care The Nichols Chem. Co., Laurel Hill, Queens Co., L.I., N.Y.

Wanted—Machinist as instructor in trade school; must not use tobacco or alcoholic beverages; state age, experience and salary desired. 149, AM. MACH.

Wanted—Draftsman and designer; one used to mining and marine work. State experience, age and salary required. Address Box 151, AM. MACH.

Wanted—Number one foundry foreman, who understands melting iron and best way of getting out castings, modern shop. Pig Iron, AM. MACH.

Wanted—Engineer for 400 H.P. Corliss type eng., Westinghouse 150 H.P. eng., 50 H.P. upright eng. Cmpsn. pumps, etc. Must be first-class machinist, sober and steady. Will be provided with ast. and fireman. Write, giving recommendation, wages expd., age and nationality, to Manufacturer, care AMERICAN MACHINIST.

Wanted—A first class, sober, reliable field foreman, to build tanks, smoke stacks, water towers, etc. Must be capable of estimating costs on field work and keeping his labor within estimate. Would be located in New York and used in that city and surrounding territory. Address, stating experience, etc., Field Work, care AM. MACH.

▲ ▲ ▲

Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d h'd lathes & planers. S.M. York, Clev'd, O.

Calipers & Gauges. F.A. Welles, Milwaukee, Wis.

Draftsmen's new conveniencies. D. J. Kelsey, New Haven, Conn.

The Dutton Wet Twist Drill-Grinder is sold by the Garvin Machine Co., New York City.

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co., Springfield, Mass.

Models, experimental and small special machy. built. Write to Crocker & Lawson, Binghamton, N.Y.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Boye, Cincinnati, O.

We make a specialty of Shartle's patent safety set collars. Prices low and samples free. Middletown Machine Co., Middletown, Ohio.

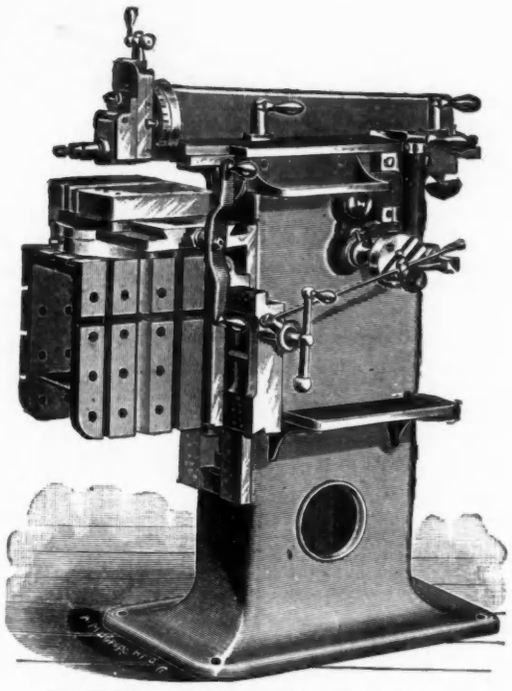
Wanted—Every reader of this paper to send 35 cents for The Tool Catalogue. See Montgomery's advertisement on page 38 of this edition.

Model Locomotives—Complete castings, latest N. Y. Cen. standard, up to date; 4c. in stamps for catalog. G. H. Olney, 163 Herkimer St., Brooklyn, N. Y.

For Sale—Garvin No. 2 screw mach. wire fd., tools, fixtures, chuck: also B. & S. No. 2 U.M. mach., large stock cutters, mach. new, Jan. Box 130, AM. MACH.

Wanted—An Idea. Who can think of some simple thing to patent? Protect your ideas; they may bring you wealth. Write John Wedderburn & Co., Patent Attorneys, Washington, D. C., for their $1,800 prize offered to inventors.

Business Opening—Foundry and machine business in East Tenn. A rare optnty. for a bus. man, machinist or molder wishing to go south; only bus. of kind in growing mfg city of over 4,000 population; reason for selling wish to engage in another line of bus. For further particulars ad. Box 101, Harriman, Tenn.



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15-inch Hendey Shaper.

Latest Improvements.
Useful Attachments.
Strong and Powerful.

...FOR...

Die Work, Tool Room or General Shop Work.

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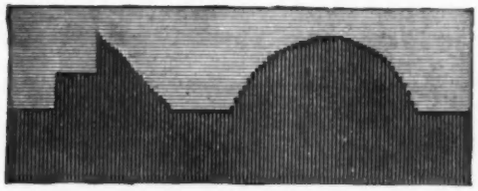
The stroke can be adjusted for curves with machine in motion. The stroke can be adjusted for angles with machine in motion. The stroke can be adjusted for irregular work with machine in motion. It has adjustable table for planing taper work; table can be removed for fastening work to apron. Has a strong graduated swivel vise. Quick work, rapid changes, modern ideas.



This cut shows how stroke can be adjusted with machine in motion by micrometer; adjustment fine and delicate. SEND FOR CIRCULAR.

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Agents for the Pacific Coast—PACIFIC TOOL AND SUPPLY COMPANY, San Francisco, Cal.

European Agents, { **CHAS. CHURCHILL & CO., London and Birmingham.**
SCHUCHARDT & SCHÜTTE, Berlin and Vienna.
EUGEN SOLLER, Basel, Switzerland.

veloped into a fairly brisk business; so that our office force is kept well employed. We have recently taken orders for two elevator-pump outfits. Several water-works are about on the point of making installations, one or two of them having already awarded contracts.

THE ENGLISH PRESS ON AMERICAN IRON TRADE COMPETITION.

A report of United States Consul Tucker, written from Birmingham, England, and published in the last monthly volume of consular reports, shows how the "Daily Post," of that city, regards the importations of American iron. It says: "There is nothing new, of course, in the importation of American pig iron, which can be produced now at prices with which English and Scotch smelters cannot pretend to compete, but it certainly is a new departure for American-made steel billets to be selling in the English Midlands. . . . The revival of business in the United States ['Tis distance lends enchantment to the view] is already lifting the cost of production in the States, and if English manufacturers could see their way to cheapen production on this side by the adoption of American plants and processes, there would be little to apprehend in the future from American competition. For the moment, however, it must be admitted that in certain lines we are beaten by our American competitors."

MISCELLANEOUS.

There is now a brisk demand for nails, and according to the "Journal of Commerce," New York, rumors are afloat of a certain "gentlemen's agreement," which is, it would seem, the ghost of the defunct Cut and Wire Nail Manufacturers' Association. The cut nail manufacturers east of the Alleghenies have agreed that the price be advanced 10 cents per keg.

The Diamond Match Company, it is said will furnish machinery for a plant in Brazil, capitalized at $1,000,000 or more, which will supply all the matches for that country.

Quotations.

NEW YORK, Monday, March 29.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$12 00 @ $12 50
No. 2 foundry, Northern	11 50 @ 11 75
No. 2 plain, Northern	10 50 @ 10 75
Gray Forge	10 25 @ 10 50
No. 1 foundry, Southern	11 25 @ 11 75
No. 2 foundry, Southern	10 50 @ 10 75
No. 3 foundry, Southern	10 00 @ 10 25
No. 1 soft, Southern	10 75 @ 11 00
No. 2 soft, Southern	10 25 @ 10 50
Foundry forge, or No. 4 Southern	10 25 @ 10 50

Bar Iron—Base—Mill price, in carloads, on dock: Common, 1.00 @ 1.10c.; refined, 1.10 @ 1.25c. Store prices: Common, 1.30 @ 1.40c.; refined, 1.40 @ 1.50c.

Tool Steel—Ordinary sizes, standard quality, 6 @ 7c., with some brands perhaps a little less; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—Ordinary brands, from store, in small lots, 1.60 @ 1.65c.

Cold Rolled Steel Shafting—Base size, 2.50 @ 2.55, in small lots, from store.

Copper—Carload lots, Lake Superior ingot, 11¾ @ 12c.; electrolytic, 11⅞ @ 11½c.; casting copper, 11 @ 11⅜c.

Pig Lead—In carload lots, 3.40 @ 3.45c., f. o. b.

Pig Tin—For 5 and 10-ton lots, 13.30 @ 13.35c., f. o. b.

Spelter—In carload lots, New York delivery, 4.15c., f. o. b.

Antimony—Cookson's, 7⅜ @ 7½c.; Hallett's, 6¾ @ 7c.

Lard Oil—Prime city, present make, commercial quality, in wholesale lots, 39 @ 41c.

Manufactures.

At Arlington, Mass., H. H. Buffum will build a machine shop.

At Denver, Col., a foundry will be erected by George G. Jackson.

At Chicago, Ill., Jacob Birk is to make an addition to his factory.

The factory of Messrs. Esterbrook, Camden, N. J., will soon be altered.

The F. D. Hart wire and iron works has been formed at Detroit, Mich.

The new electric power-house at Northboro, Mass., is nearing completion.

The McKenne Rolling Company, of Joliet, Ill., will erect a new steel works.

Millard & Co., North Adams, Mass., intend to add new machinery to their plant.

J. F. Kenmerer, Berks street, Philadelphia, Pa., will make an addition to his mill.

At Millville, N. J., George Wood, of Philadelphia, will build a window-glass plant.

S. H. Wiley, Salisbury, N. C., intends to install machinery for paper box manufacture.

The Rand Drill Company, of Tarrytown, N. Y., is erecting an addition to its works.

Mr. Elan Zimmer, of Piqua, contemplates the erection of a new mill at Hopkinsville, Ky.

The sawmill of H. S. Austin, at Edwardsville, N. Y., has recently been destroyed by fire.

At Nyack, N. Y., D. H. McConnell proposes to erect a building for manufacturing purposes.

At Sing Sing, N. Y., the completion of the Sullivan Marine Engine Works is being pushed.

The John P. King Manufacturing Company, of Augusta, Ga., will erect a new mill in the near future.

The mill of Gamble & McKenneth, at Lafontaine, Wabash, Ind., was recently destroyed by fire.

The foundry of the Glenville Machine Company, at Glenville, Pa., was recently destroyed by fire.

A large addition is being built to the Seymour Manufacturing Company's tube works at Seymour, Conn.

At Louisville, Ky., the Stewart-Crane Paper Company has been incorporated. John E. Crane is interested.

The plant of the Acme Bicycle Works, Reading, Pa., was recently destroyed by fire. The plant will be rebuilt.

It is now definitely known that the Shenango Valley (Pa.) Steel Company will erect an addition to their plant.

J. Gibson McIlvaine & Co., of Philadelphia, Pa., will erect a new planing mill, 66 x 175 feet, and three stories high.

The New York office of the Philadelphia Engineering Works has been removed from No. 126 to No. 120 Liberty street.

The Georgia & Alabama Railroad will locate it shops at Americus, Ga. These, when finished, will cost about $70,000.

The plant of the Titusville Milling & Rubber Reclaiming Company, Titusville, N. J., was destroyed by fire recently.

Wolfe Bros. & Co., of Pittsburg, Pa., will commence the erection of a factory just as soon as the site can be found.

The planing mill of Henry Gans & Sons, North St. Louis, Mo., was recently destroyed. Much of the machinery was damaged.

At Alexandria, Va., the Smith Flexible Chain Company has been organized. Mr. E. J. Smith, of Washington, D. C., is president.

At New Paynesville, Minn., D. F. Chandler,

(Continued from page 37.)

This is our No. 5 Grinder in miniature. It shows the general design of our goods. Notice the engine lathe boxes. What do you want in the line of grinding machinery?

DIAMOND MACHINE CO., Providence, R.I., Chicago, Ill.

London, CHAS. CHURCHILL & CO., Ltd.
Paris, FENWICK FRERES.
Berlin, SCHUCHARDT & SCHUTTE.
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For MACHINISTS, ENGINEERS and STUDENTS.

GAS, GASOLINE AND OIL ENGINES.

By GARDINER D. HISCOX, M. E.

A book designed for the general information of every one interested in this new and popular motive power, and its adaptation to the increasing demand for a cheap and easily managed motor requiring no licensed engineer.

Price, $2.50.

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By ROBERT GRIMSHAW, M. E.

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By ROBERT GRIMSHAW, M. E.

Nearly 400 Pages. 222 Engravings.

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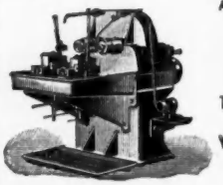
15 Beekman Street, NEW YORK.



Automatic Solid Die Bolt

THREADING MACHINES.

Two Styles. Four Sizes.

Send for Catalogue "A."

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SCHOOL OF MINES,
SCHOOL OF CHEMISTRY,
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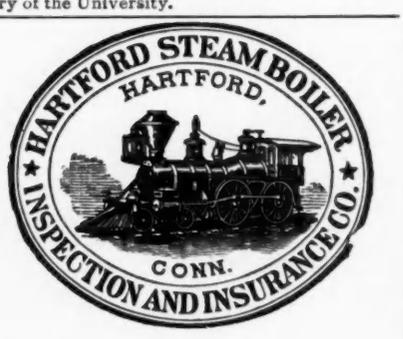
Four years' undergraduate courses and special facilities for graduate work in all departments. Circulars forwarded on application to the Secretary of the University.



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WM. B. FRANKLIN, Vice-President.
F. B. ALLEN, Second Vice-President.
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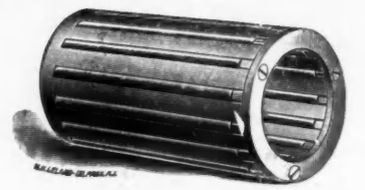

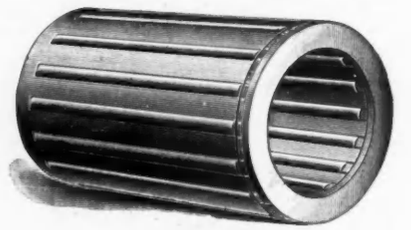

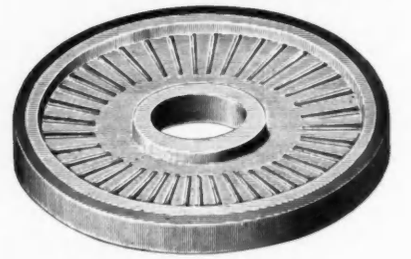

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Roller Bearings

REDUCE FRICTION AND SAVE POWER.

Applicable to all Classes of Machinery.

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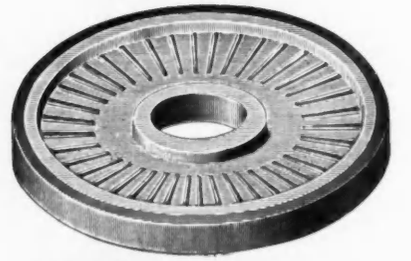

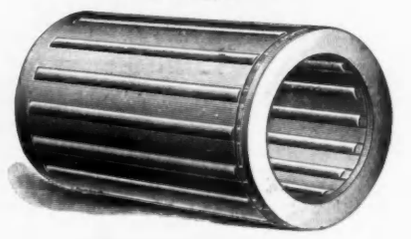

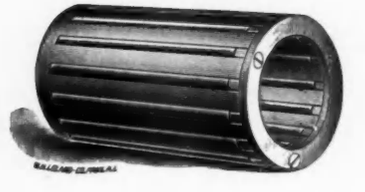

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All these are comprised in the make-up of our lathes and are the four necessary points in the construction of a good tool. Add to these a FIFTH and a very important one, the price, which we make very low to prompt cash buyers, and you have the story. Our Catalogue will tell you all about our Lathes, Planers, Shapers, etc.

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Have done all my patent soliciting work, both for this and foreign countries, continously for the past fourteen years.

Thomas A. Edison

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At Chicago, Ill., the Chicago Flexible Shaft Company has been formed. Incorporators: Charles S. Burton, E. T. Wray and D. M. Carter.

At Chicago, Ill., the Acme Journal Bearing Company has been formed. William Hamilton, Frank W. Thayer and Lewis H. Mitchell are interested.

At Trenton, N. J., the Heywood Bros. & Wakefield Company has been incorporated. The incorporators are F. H. Hitchcock and John D. Walsh, of Brooklyn; G. H. Gardiner and F. J. Boyer, of New York.

Orland W. Hart, of Fall River, Mass., is the president of a new company known as the United States Signal Company, of Portland, Me., for the purpose of manufacturing electrical and mechanical apparatus.

The Hoffman & Billings Manufacturing Company, of Milwaukee, Wis., will remove its works to Gadsden, Ala., and consolidate with the Weller Pipe Company, and the new concern will be known as the Hoffman, Billings & Weller Manufacturing Company.

A deal has just been made by which the Central Iron Works, Paxton Rolling Mills and Charles L. Bailey & Co., Harrisburg, Pa., have disposed of their plants to a new corporation, to be known as the Central Iron & Steel Company. The incorporators of the new concern are Charles L. Bailey, J. D. Cameron, etc., etc.

The Payne Engineering Company, composed of Messrs. Stephen H. and Norman B. Payne and Albert G. Duncan, who was formerly with Westinghouse, Church, Kerr & Co., has been organized, and will handle, as sole agents, the Payne steam engines, which will hereafter be manufactured by the Wright Steam Engine Works, Newburgh, N. Y.

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New Catalogs.

There are three sizes of Standard Catalogs, first authorized by the Master Car Builders' Association, 9" x 12", 6" x 9" and 3½" x 6". We recommend the 6" x 9" size for machinery catalogs. When they must be larger or smaller, one of the other standard sizes should be adopted if possible.

The Q. & C. Company, Chicago, Ill., send us a catalog illustrating and describing the McKee brake slack adjuster. The catalog is standard size, 6 x 9 inches.

We have received from the Whitlock Machine Company, Derby, Conn., a pamphlet, in which is illustrated and described the Whitlock pony printing press. The pamphlet is 6¼ x 10 inches.

We have received from the Link-Belt Machinery Company, Chicago, Ill., a catalog containing illustrations and descriptions of coal and freight conveying machinery. The catalog is standard size, 6 x 9 inches.

The John M. Rogers Boat, Gage & Drill Works, Gloucester City, N. J., have sent us a catalog containing descriptions and illustrations of measuring machines, caliper gages, reamers, mandrels, etc. The catalog is 3¼ x 6 inches.

We have received from the Hayden & Derby Manufacturing Company, New York, a catalog which contains descriptions and illustrations of injectors. The catalog is 5¼ x 8½ inches, and will be sent to those interested on application.

We have received from Patterson, Gottfried & Hunter, Limited, New York agents for the J. M. Carpenter Tap & Die Company, of Pawtucket, R. I., a catalog and price list of taps and dies, die holders, screw plates, etc. The catalog is 3½ x 5½ inches.

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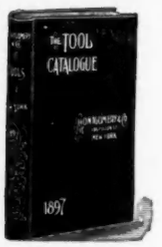

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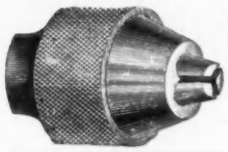

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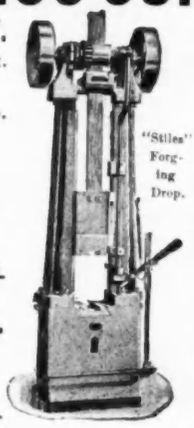
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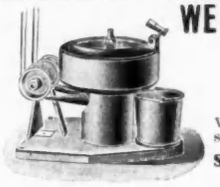

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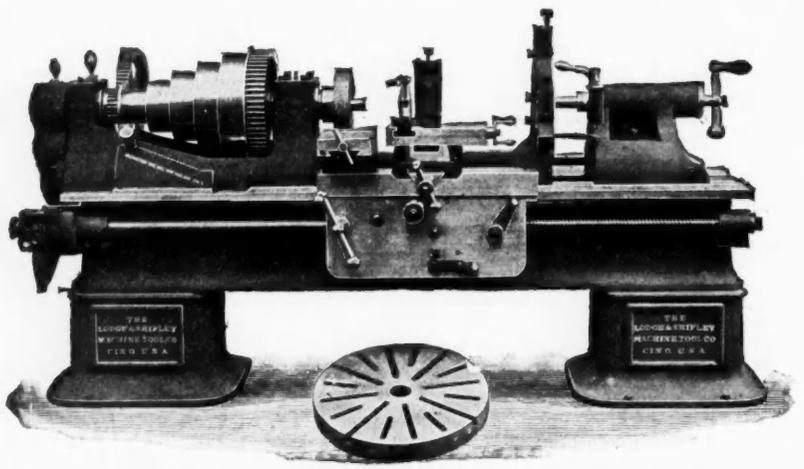

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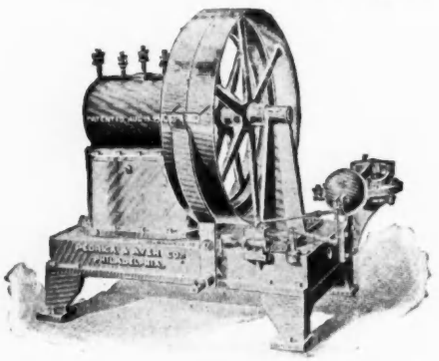

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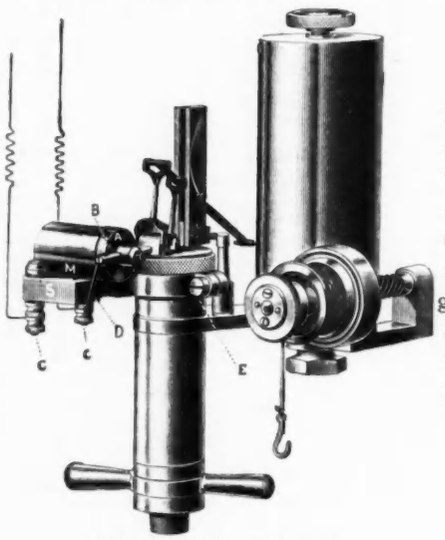

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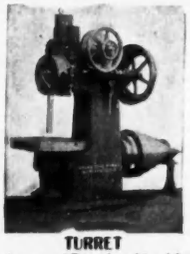

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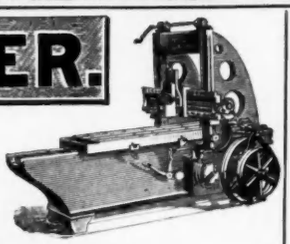

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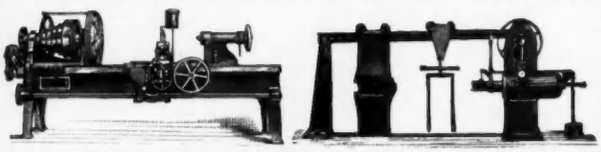

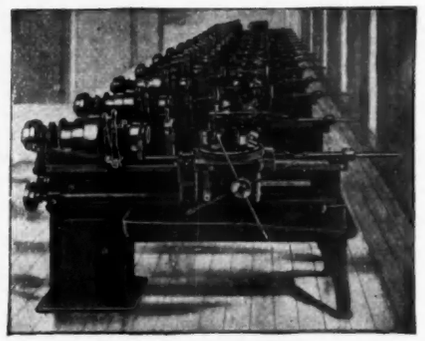

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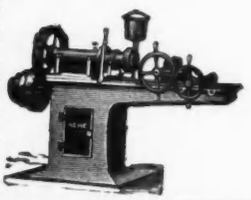

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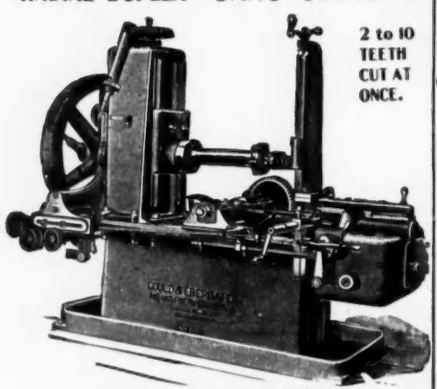

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